THE JOURNAL
of the
AMERICAN DENTAL ASSOCIATION

Vol. 26 APRIL 1939 No. 4

TRAUMATIC OCCLUSION

By JOHN OPPIE MCCALL, D.D.S., F.A.A.P., F.A.C.D., New York City

A LITTLE more than twenty years ago, Paul R. Stillman presented to the dental profession the phrase "traumatic occlusion." In so doing, he crystallized the conception that both he and a few other periodontists of that day had of a type of malrelationship of the teeth that caused periodontal injury. The thing we know as traumatic occlusion was known before the time of Stillman's coining of the phrase. Here and there in the literature, especially of very early times, we read advice as to the "filing" of loose teeth so that they may become firm. These suggestions were, however, passed over by those who thought they knew better, until the time I have already mentioned.

It seemed to require the stimulus of improving knowledge of periodontal disease and improving technic in case management to bring about a realization of the true rôle of traumatic occlusion in periodontal disease to those laboring in the field. Thus, along with the clearer conception of periodontal pathology and standardizing of technic, traumatic occlusion took its place in the ushering in of what may well be called the golden age of periodontia.

The development of the mechanisms under which this hitherto unnamed force operated has been a fascinating study. It has been interesting, too, to see the opposition to acceptance of this principle which was, for some time, voiced by prominent practitioners, teachers and research workers melt away. Today, it is accepted that traumatic occlusion, the least tangible thing in the human mouth, has harmful effects that can themselves be definitely detected and that the elimination of these sequelae demands relief of this causative agency.

I take it as my province here, then, to discuss what traumatic occlusion is, on what tissues it acts, how these tissues react to it and its relief.

Traumatic occlusion has been variously defined and none of the definitions is entirely satisfactory. Leaving definitions aside, what we recognize when we see a case in which traumatic occlusion has been at work is a relation of one or

Read before the Section on Periodontia at the Eightieth Annual Session of the American Dental Association, St. Louis, Mo., October 26, 1938.

more teeth to their antagonists in the other jaw that is causing damage. We realize that these particular teeth are striking too hard when the jaws are brought together.

I have said that traumatic occlusion is the most intangible thing in the mouth. The reason for this is that contact of opposing teeth is a normal expectancy of the dentition. Teeth were put in both upper and lower jaws for use in the grinding and cutting of food, and to perform these functions effectively they must meet at the conclusion of the biting or chewing stroke. Thus, when the jaws are closed and the teeth meet, we see that they are in contact and we recognize that as proper. What we cannot see is the relative force with which various teeth meet in the mouth and the ability of the supporting structures to withstand that force. Nor does it help us to try to measure the occlusal force being exerted. Measuring instruments simply tell us the tolerance of the supporting dental tissues at the time, while the thing we are interested in is the tolerance to repeated impacts of the teeth. Furthermore, the pressure tolerated in one mouth without harm may cause serious harm in the next one.

The existence of traumatic occlusion is readily visualized when gross malocclusion is present, but it is less easy to conceive of its existence when the occlusal relations of upper to lower teeth seem to be normal or nearly so. Yet some of the most serious manifestations of this condition are to be found in the latter type of case. It therefore becomes necessary to ask ourselves what it is, in the way of occlusal relations, that may cause the harm that we associate with the term "traumatic occlusion."

First it becomes necessary to reiterate a statement that what causes harm in one mouth may not have such an effect in another. This implies a difference in tissue strength and tolerance and, probably, in the systemic background of the two cases. In other words, occlusion is traumatic when the supporting tissues of the teeth involved undergo pathologic change as a result of occlusal stress. Thus, it follows that there are two factors in every case of traumatic occlusion: one, the occlusal relation itself; the other, the tolerance of the supporting tissues.

Any malposition may cause traumatic occlusion if it is of such nature that either in centric occlusion or in the various contacts incident to mastication, there is an uneven distribution of stress throughout the arch. Prominent examples are excessive overbite of the anterior teeth, drifting of teeth following extractions, inharmonious buccolingual relationships of upper and lower posterior teeth and abnormal mesiodistal relations of the upper and lower bicuspids.

Of these, the latter two need some elaboration. Quite often, it is found that the upper molars and bicuspids are set more or less edge-to-edge as regards their buccal cusps; an invariable source of trouble. Less common, but still more injurious, is the occasional malposition in which an upper bicuspid, for instance, closes entirely to the buccal aspect of the lower tooth. When the lower bicuspids are set either mesially or distally to their proper position, their buccal cusps do not glide between the cusps of the upper teeth in lateral occlusion, but ride on those cusps; which causes traumatic occlusion.

In addition to traumatic occlusion from malposition, of which the foregoing are typical examples, trauma may also be caused in normal occlusion by the presence of oversized or malposed cusps of posterior teeth or oversized marginal ridges of upper anterior teeth. It is often caused in normal occlusion by tight interlocking of upper and lower cusps, especially if these are long and pointed.

It will be seen that conditions are present in almost all mouths for the development of traumatic occlusion, and this is, in fact, the case. The question

arises, therefore, as to how any one ever escapes this condition. Fortunately, nature has a way of meeting this situation in many cases, but a way of which few today take advantage. This is the equalizing of stress through wearing down of those teeth that are striking the hardest. This compensating wear is normally accomplished through the vigorous mastication of coarse, fibrous foods. Since civilization has largely eliminated such foods from the dietary, but little natural wear is seen in the teeth of modern people.

We must now resort, in less severe malposition and malformation, to grinding at the hands of the dentist. Orthodontia must come to the rescue in many cases, however. There is, of course, the alternative, for the former class of cases, of providing the patient with a chewing gum charged with abrasive powder, to be used, however, under careful supervision. This would provide somewhat the same effect as the chewing of tobacco, which, because of the silica content, causes a characteristic abrasion of the teeth. The effect would have to be regulated and not allowed to go on indefinitely as in the case of the tobacco chewer. Also, it would be necessary to be sure that mastication of the abrasive gum could be carried out in all parts of the mouth, and to warn the patient that mastication should include adequate lateral movements for the reduction of interlocking cusps, and protrusive movements for balancing the stress on the anterior teeth.

As regards the effects of traumatic occlusion, attention has been focussed almost entirely on changes occurring in the periodontal membrane, together with the alveolar bone and gingiva. This is fitting up to a certain point, since it would appear at present that in the greatest number of cases in which this injurious agency is found, the principal damage is found in those tissues. To stop with the consideration of periodontal disease is, however, to acquire a one-sided view of the situation. The fact is that pulp damage, often of a severe nature, is a fairly common result of traumatic occlusion. Before considering either pulp or periodontal disturbance, however, let us study the mechanism through which injury is occasioned.

The pericementum, or periodontal membrane, is the cushioning medium which softens the shocks transmitted to the alveolar bone when pressure is applied to a tooth. Since both tooth and bone are relatively rigid, the periodontal membrane may not only be compressed during the application of such pressure, but also, if the pressure is great enough, may actually be pinched. In any event, this tissue is the first to feel the effect of traumatic occlusion. If the pinching effect just mentioned is severe enough, the periodontal membrane may undergo necrosis in small areas. If the pressure is less severe, there ensues a circulatory disturbance, which may be reflected in one or more of three directions: the pulp by way of the tooth apex, the alveolar bone by direct extension and the gingiva by extension along the vessels of the pericementum itself.

PULP REACTIONS TO TRAUMATIC OCCLUSION

Let us consider first the effect of traumatic occlusion on the pulp, a chapter of this story which has had all too little attention heretofore. Teeth in which pulp disturbance is being induced usually develop symptoms of pulp hyperemia and pulpitis. Undue sensitiveness to cold is usually the first symptom. The relief afforded by adjusting the occlusion is sufficient proof of the relationship between cause and effect. If the occlusion is not improved, the symptoms continue and not uncommonly an actual pulpitis sets in, with reflex nerve disturbances and sometimes pulp death. Only recently, I treated a young woman who had a neuralgia involving the side of the face and extending down into the arm. The case

was complicated by infection from a retained root, but considerable relief was given by lightening the occlusal pressure on the affected side.

Quite often, the pulp pain is felt after a tooth has been filled. Here, the injurious occlusal relation may have been in existence for some time without causing symptoms, but when the cavity is excavated and filled, even though the filling itself is not too high, the pulp reaction becomes exacerbated and pain is felt. In these cases, too, relief of the occlusion brings relief of the symptoms.

Pulp reactions to traumatic occlusion are particularly common in children who have experienced shifting of teeth due to untimely extractions. It is a common experience at the Guggenheim Dental Clinic to have complaints of toothache in first permanent molars after filling. Nearly always in these cases, it will be found that a deciduous molar has been extracted prematurely and the permanent molar has drifted mesially, changing its occlusal relation to the opposing teeth. Grinding of contacting points invariably gives relief, if the pulp had proper protection when the tooth was filled. I commend consideration of this experience to all who are caring for children in their practices.

One word more about pulpitis and traumatic occlusion: It is usually found in the young, as just indicated, and in those adults who exhibit unusually strong, resistant alveolar structures. The explanation would seem to be that, in these cases, the bone does not become resorbed under stress as in the case of periodontal disease and the circulatory disturbance is therefore forced in on the pulp, as it were.

If the pulp disturbance is less severe, there may be no pain, but, in many instances, evidence of pulp stone formation will be found in the roentgenogram.

A disturbance which can usually be traced to traumatic occlusion and the distressing effects of which can almost always be relieved by correction of the disturbed occlusion is pain in the region of the condyle of the jaw. Very often, this is induced by constant forcing of the condyle, usually on one side only, a little forward of its natural position by the locking of cusps of teeth that have shifted following extractions at an earlier period. This seems to put a constant strain on the ligaments even if it does not bring about changes in the form of the bones and cartilage making up the temporomandibular articulation. The result is pain which may be very severe at times. Correction of the occlusion will give relief except in patients of advanced years.

We now come to the consideration of periodontal disease, especially that type in which traumatic occlusion is the predominating cause and which has been called by Box "periodontitis complex." It is this phase of the subject which has received the greatest attention and regarding which, because of that fact, the least need be said here. In this type, the effect of the traumatic occlusion is to induce resorption of the alveolar bone, evidently through the medium of the circulatory disturbance in the periodontal membrane. This probably acts by setting up osteoclastic activity along the inner wall of the alveolar process and, in many cases, by resorption due to penetrating processes from the pericementum extending into the bone. Gingival disturbance and infection follow, with, eventually, pus pocket formation.

What should interest us today is not the alveolar resorption or the relationship between this and the traumatic occlusion. What we need to know now is why resorption occurs in some cases and not in others that have a similar occlusal pattern; why it occurs in one individual at 21 years of age, and in another, with virtually the same occlusal disbalance, it does not manifest itself until age 40.

Reflection on the cases seen over a period of years makes it clear that trau-

matic occlusion does not cause bone resorption by its mere presence in the mouth. To have bone resorption, there must be a bone susceptibility. Consideration of this phase of the subject necessarily takes us into the field of general metabolism, a virtually uncharted sea as far as I am concerned. Whether the background is a vitamin deficiency, a mineral deficiency or a lack of balance in the intake of the primary foodstuffs is not for me to say. Nor can I make any statement about endocrine disbalance in this disease other than to say that I do not, in the great majority of cases, take much stock in it.

As so many of the patients who are suffering from periodontitis complex are sent back by the physician that they are referred to, with negative reports, I feel that we have no present means of ferreting out the systemic difficulty. Heredity offers a lead in a considerable number of cases, but whether the transmission is that of a taint, such as attenuated syphilis, is, at present, a matter of conjecture.

What we can say about periodontitis complex is that traumatic occlusion is always a factor in its etiology. To state it in another way: Without traumatic occlusion, we do not have periodontitis complex; possibly the simplex type, but not the complex. Also, we can say that, in practically all cases of periodontitis complex that are not too far advanced, cure can be achieved without reference to the systemic factor if the occlusion can be rendered innocuous and the other local factors be brought under control.

Before leaving the consideration of periodontitis complex, I should, I believe, mention some of its chief clinical characteristics, particularly as these are directly related to the traumatic occlusion that has so much to do with its inception. Most conspicuous, if not the first lesion to show itself, is the pus pocket. In the fairly early stages of typical cases, this pocket is deep in relation to its width and appears on one side of the tooth root while the periodontal attachment is intact on the remainder. It is this characteristic which led to the rather colloquial designation of this type as "vertical pyorrhea."

Let us see what the connection is between this deep narrow pocket and traumatic occlusion. The occlusal disbalance, as usually manifested, presses harder on one side of the tooth than the other and thus causes greater compression, or stretching (and this is very important), on one side of the root than on the other. In other words, the injury of traumatic occlusion tends to be localized on one side of the tooth. Also the force, being apical in direction as well as lateral, in most cases, involves the pericementum along the side of the root as far as the rotation point (a point, seldom at the apex, around which the tooth rotates under stress). Thus, when gingival resistance wanes, from whatever cause, infection and lysis of the periodontal membrane ensue and the lesion follows the line of least resistance; i.e., the area of injury from the occlusal overstress.

Preceding the actual development of the pus pocket, there has been, first, a slight resorption of bone in the line of stress, and, second, an inflammation of the marginal gingiva. These are seen as (1) slight thickening of the dark line which, in the roentgenogram, represents the pericementum, and (2) redness of the gum margin. The latter, in some instances, is confined to a small segment of the gingival margin. This apparently indicates that the circulatory disturbance which paved the way for the infection of this tissue was directly related to the overstress that had been acting on that part of the pericementum directly adjacent to and in line with this area.

Phenomena such as these can be discerned and their relationships analyzed only in the early stages of periodontitis complex. As the disease progresses, the periodontal lesions spread laterally, and

the previously narrow pocket becomes wider. With this, of course, there goes a corresponding lateral extension of the bone resorption and involvement of the entire gingival margin in the inflammatory process. This generalizing of the disease is especially apt to occur on the lower anterior teeth because of the small root area. Under such circumstances, it is not so easy to demonstrate, even in moderately advanced cases, that we are actually dealing with periodontitis complex and not periodontitis simplex, or so-called horizontal pyorrhea. As most dentists in the past have paid no attention to cases of periodontoclasia until they were in an advanced stage, the characteristic phenomena of periodontitis complex escaped their attention, and there was, for that reason, no realization that this was a definite form of periodontal disease with a characteristic etiology.

Since it is so very advantageous, and important as well, to detect traumatic occlusion before it has caused any considerable damage, it is desirable to know what the early signs of traumatic occlusion are. Most of the attention given to this force in the past has been in the field of periodontia, as I said before. In this field, the most complete compilation is Box's twenty signs, published in his epochal "Studies in Periodontal Pathology."[1] Of these, the ones most commonly seen are the periodontal thickening and gingival inflammation already mentioned. The latter requires a differential diagnosis because it can be caused by conditions other than traumatic occlusion.

Gingival recession, especially if asymmetric, is an early sign of this condition. This also requires differential diagnosis, as in the case of gingivitis. It is often seen in children and is even more definitely related to traumatic occlusion in the child than in the adult. It may affect deciduous as well as permanent teeth.

Mobility of slight extent is a pathognomonic sign of traumatic occlusion. However, once in a long time, a case of pericementitis of apical origin may exhibit mobility without the extreme tenderness usually found in that condition. Mobility may often be found before pocket formation has begun and even before there is any extensive bone resorption.

Bone resorption, especially if asymmetrical, is one of the prime indications of periodontal disease due to traumatic occlusion. This is, of course, detected in the roentgenogram and study of the x-ray picture is therefore a cardinal item in the diagnosis of this condition. The most characteristic sign observed is the thickening of the pericementum mentioned before, especially when this is seen on one side of the root only. Pericemental thickening entirely around the root is seen, however, in many cases. A phenomenon that I have recently observed has to do with the latter condition. In patients about 12 years of age seen at the Guggenheim Dental Clinic, who have lost a first permanent molar, and have had the usual drifting of the other teeth, x-ray films will show thickening of the pericementum, not only around the posterior teeth, but even around the anterior. Often, this is the only sign of periodontal disturbance in the mouth. The conclusion is inescapable that this is an early sign of periodontitis complex and that it is related to the occlusion derangement that goes with the shifting of the teeth. I need only remind you here that, in the adult, periodontal disease is almost invariably—I think I may even say invariably—found in mouths where first permanent molars have been extracted without immediate insertion of some form of space maintainer.

Bone resorption from traumatic occlusion may also take the form of a melting away of the alveolar crest, but this may

1. Box, H. K.: Studies in Periodontal Pathology. *Canad. D. Res. Coun. Bull. No. 7*, Toronto, 1924.

be difficult to differentiate from the bone resorption induced purely by gingival infection, in other words, in cases of periodontitis simplex.

TREATMENT

And now we come to the question of what to do about traumatic occlusion. How can we prevent its occurrence or eliminate it if it has occurred? Naturally, we will make every effort to assure the development of normal occlusion in our child patients and will have malocclusion treated when it does occur. This may not be enough, however, as I said early in this paper. Anatomic variations of individual teeth or long pointed cusps may still cause trouble, even when the occlusion is good. I am satisfied, as I hinted before, that controlled wear must be induced, if the patient does not show signs of producing this wear himself; and the wear must be of such nature as to reduce interlocking of cusps. I mention this because I have all too often seen wear induced by use of the "chop" stroke in chewing, which only served to lock the cusps more and more securely, with the consequences to be expected in such a condition.

On the correction of traumatic occlusion, an entire paper could be written, and much has been written. Grinding is the method most commonly used. In many cases, however, grinding can give only partial relief. This is particularly true when there is an excessive overbite of the anterior teeth. Here, orthodontic treatment is indicated, and this may be done not only for the young, but even for the middle-aged. Opening of the bite is not successful in these cases except when combined with orthodontic treatment and then is usually not needed.

In the case of incipient periodontal disease, if grinding is to be done, it is usually best to start with the anterior teeth and bring them into a state of balance in both centric and protrusive occlusion. Establishment of balance in centric position is determined by placing the tips of the fingers lightly, very lightly, on the upper incisors, while the patient closes the teeth rather smartly. There should be no displacement nor even a marked jar as the teeth make contact. It is usually well even to create a slight space so that a sheet of tissue paper can be drawn from betwen these teeth without tearing. This space will soon close up by elongation, and such growth will cease when the teeth just begin to make contact once more, and there will thus be no reestablishment of the traumatic occlusion.

After this is accomplished, the protrusive occlusion is adjusted. Here, it is desirable to have the relations such that when the anterior teeth are in edge-to-edge contact, there will also be one or more points of simultaneous contact in the posterior part of the mouth. This posterior contact is not always essential, its importance depending on the periodontal condition of the anterior teeth, but it is always helpful in the avoidance of undue strain on these teeth. At the least, there should be even contacts from cuspid to cuspid when the anterior teeth meet in protrusive position.

Attention is next given to the posterior teeth. Their occlusion is first checked in centric position. If any of these teeth show definite signs of periodontal disease, grinding should start at that point. If there are no signs of disease, we start on a tooth or tooth cusp that seems to be out of harmony with the general line of occlusion or that shows a facet of wear indicating that it has been striking hard. Carbon paper may be used to indicate the points of actual contact, but cannot be relied on to indicate how hard adjoining teeth are striking. This may usually best be determined by the patient, whose estimate of relative pressure is almost always accurate. Grinding should not, of course, proceed to the point of disoccluding the tooth, unless it is in an advanced state of disease.

When the occlusion of the first posterior tooth has been adjusted, the patient is asked to indicate which tooth or teeth are now striking hard. Grinding is transferred to the point indicated whether on the same side of the mouth or not, continuing from point to point until the patient no longer is conscious of any one tooth striking harder than another. The procedure up to this point will usually have been conducted in centric occlusion only. Occasionally, the patient will call attention to points that interfere in tentative lateral excursions, and these are taken care of as attention is drawn to them. The main attention, however, is directed toward securing balance in centric occlusion.

With this accomplished, the elimination of interference in lateral excursions is taken up. Here, we become interested in the riding of cusps on opposing cusps. Frequently, it will be found, on studying the occlusion in lateral positions, that two opposing cusps are providing the only points of contact while the jaws are in that position. These will naturally receive the first attention. Even if this is not the case, it will usually be found that where there are symptoms of damage from traumatic occlusion, cusp height in general is such as to cause undue stress in lateral excursions. This calls for a general reduction of cusp height. The idea is, of course, to facilitate lateral movement and thus to encourage wider lateral excursions during mastication. A word of warning is in order here: While most dentists are apt to grind so little that they give the patient no real benefit, others may go too far and cause real injury. We must never be afraid to take off enough enamel to make a perceptible difference in the relations of the teeth being treated. At the same time, it is the part of wisdom not to set a predetermined line and hew to it, so to speak. Let us put the teeth in balance, with moderate change in cusp height, and observe the results. The same caution may be applied to the grinding of the anterior teeth.

We should always remember that when balance has been achieved, the patient will accept it, but not until then. Carbon paper marking, finger tip tests, visual examination—all are less reliable than the patient's tactual sensitivity. Until this is satisfied, the task is not finished—and it may take a long time to achieve that result.

Another thing to keep in mind is that tooth form and cusp form should be kept within the normal pattern. We do not wish to destroy cusps even though it may be necessary to modify them considerably. When the grinding is finished, the major features of the tooth form should be clearly recognizable. The same principle applies to the anterior teeth, especially the upper. We must not leave the incisal edges in an unbroken straight line from one cuspid to the other. The corners of each incisor and of the cuspids are shaped to approximate the form that these corners had in the beginning. This avoids the tombstone appearance that these teeth would have otherwise. Incidentally, remodeling of anterior teeth, shortening unnaturally long ones and rounding the corners as just described, will improve the appearance of many a smile and earn undying gratitude, even when this is not demanded for the treatment of periodontal disease.

In conclusion, let me remind you that traumatic occlusion is a cause of disease of the pulp as well as of the periodontal tissues: that when it attacks the periodontium, the result is a characteristic form of disease which can only be satisfactorily treated by including correction of occlusion in the scheme of case management; that its presence can usually be detected from the symptoms; that it always occurs when shifting of permanent teeth follows extraction of adjoining teeth, and that it will be found in nearly every adult mouth unless there has been compensating wear or correction of the occlusion by the dentist.

DEMONSTRATION OF POSSIBLE ILL EFFECTS OF HEAT ON THE PULP CAUSED BY RAPID OPERATIVE TECHNIC

By CHARLES F. BODECKER, D.D.S., F.A.C.D., New York City

THE attention of the dental profession has often been called to the possibility of harming the dental pulp by the speedy preparation of teeth for extensive reconstruction such as the placing of jacket crowns. According to Hartman,[1] "Most of the putrescent pulps and abscesses which follow the placing of crowns on what seemed to be perfectly normal teeth before the preparations were made may be traced back to the heat generated in making those preparations." It is a coincidence that a current editorial[2] also takes up this subject:

> Anesthesia as we practice it in dentistry may not be wholly an unmixed blessing. What about the loss of healthy pulps following cavity preparations when anesthesia is used? Too many pulps have been lost in this way, and more will be lost unless our operators exhibit greater caution.

The reason for the present discussion of this subject is that an advance has been made in the knowledge of the dentin. This knowledge permits us now to visualize the mechanism of one phase of pain transmission and further allows us to realize that, when irritation of the pulp goes beyond a certain point, harm may result.

Rapidly revolving instruments create heat, unless an effort is made to cool the affected area by water or air. Operators do not always realize the high degree of heat that is generated while working with rapidly revolving instruments. It is only in polishing an inlay, held in the hand, that this fact is brought home directly. Many of us have dropped inlays when they have become too hot for the fingertips.

The heat generated by friction is, when transmitted to the dental pulp, one of the causes of pain during operations on vital teeth. The presence of nerves in the dentin has not been demonstrated definitely. Should these be present, a second mechanism of pain transmission is possible. But to return to the subject of heat: Patients can sense this even in a pulpless tooth. It is true that they feel no pain, but if the tongue touches the tooth or filling after rapid grinding, they become conscious of a marked warmth. These facts are mentioned as evidence that drilling or grinding generates heat intra-orally as well as extra-orally.

Efforts have been made to measure the degree of heat developed in the pulp chamber during the grinding of the enamel and dentin. As far as can be ascertained, this has been done only in laboratory tests. Bronner[3] observed that grinding with moderate pressure on the periphery of the dentin with a five-eighths inch carborundum wheel for forty-five seconds raised the temperature 15° C. (27° F.) in the pulp chamber. Raising the temperature of the dental

*Presented as part of the report of the Scientific Research Committee of the Dental Society of the State of New York, Syracuse, N. Y., May 11, 1938.

From the Laboratory of Oral Histology, School of Dental and Oral Surgery, Columbia University.

pulp results first in pain. If such a warning is made impossible through the use of anesthesia, the dentist is no longer guided by the reaction of the patient, and he, as well as the patient, is unconscious of the harm that is being done to the pulp. As a result, he often continues with the rapid cavity preparation.

Pain is a sensation from which every one wishes to escape. Yet we often forget that the purpose of the nerves is to protect the body against injury. Cases of severe burns have been reported, when the sensory nerves have been paralyzed. The fact that the natural protection of the teeth is absent under anesthesia requires that even more care be exercised at this time during operative procedures. Such a warning applies more to dental operations than to major surgery. The knife makes wounds which will heal, but the rapidly rotating instruments generate heat which may cause necrosis of the pulp, a condition which is irreparable.

Some work has been done concerning the effect of heat on the vitality of tissues. Hudack[4] states that tissue changes begin to take place at 106° F. and change irrevocably at 110° F. He showed that exposure of the ear of an anesthetized mouse to a temperature of 45° C. (a rise of 8 degrees C. over normal) for fourteen minutes caused considerable edema. In this experiment, the rate of circulation was greatly increased, thus tending to carry away the heat from the ear. It is known generally that the skin of human beings can withstand great temperature variations as long as circulation is active. On the other hand, much greater harm results when the circulation is reduced. This is shown by experiments made by Lewis,[5] who observed that mammalian tissues freeze in

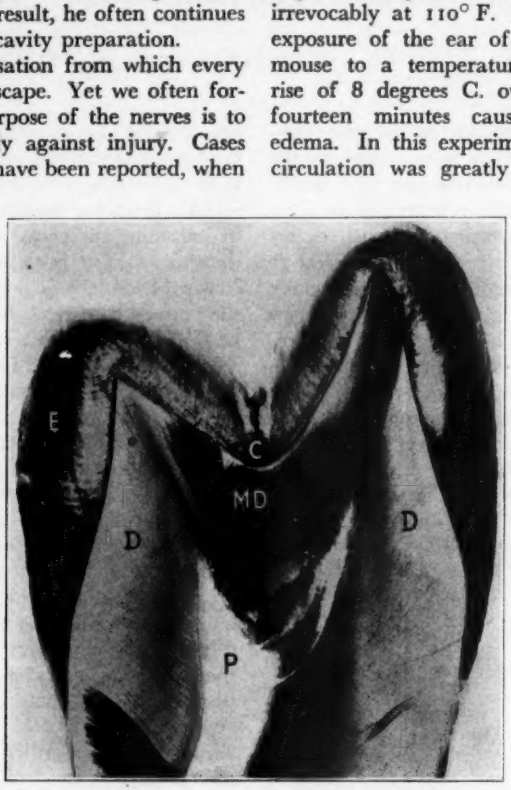


Fig. 1.—Section of bicuspid showing matured dentin (MD) having low permeability; unmatured dentin (DD) highly permeable. Operations on the latter irritate the pulp (P) more than in areas MD. E, enamel; C, beginning caries of enamel fissure.

the absence of circulation at a temperature of less than 1 degree below freezing point.

The gravity of the changes in the tissues depends on the time of exposure to heat and cold. For instance, the entire body may be exposed to a temperature of 150° F. for one second without ill effects, if the circulation is good. The same degree of heat, applied to a point for the same length of time, will produce a blister. The latter statement bears only on the effect of heat on the skin which, as has been stated, can withstand great temperature changes. The subcutaneous tissues, to which the dental pulp belongs, are much more susceptible to heat.

Further work is necessary to measure the degree of heat developed in the dental pulp chamber of the living subject as a result of grinding teeth at controlled speeds. Laboratory tests show that a considerable rise in the temperature occurs in the tooth. As already mentioned, such heat is imperceptible to the patient while under the influence of procaine anesthesia; therefore, it is only natural that the dentist shall speed up his work under such ideal operating conditions. It must be remembered that some operating time is lost before complete desensitization of the dentin is obtained by means of infiltration or conductive anesthesia. As the patient no longer senses any pain, the operator is all too apt to work rapidly in order to make up for lost time.

Fig. 2.—Beginning of maturing of dentin. Tubules originally contain dental lymph (DL). This decomposes to form a gas (G) and later calcific plugs.

In order to comprehend the effect of heat on the pulp, generated by rapidly revolving instruments in the dentin, it is necessary to review briefly the histology of this tissue. Dentin is composed of a matrix or basic substance through which run countless microscopic tubules having an average diameter of 2 micra (two twenty-five thousandths inch). It is calculated that an average of 25,000 tubules pass through a square millimeter of matrix. Consequently, a No. 1 round bur contacts at the same moment more than 19,600 tubules.

Evidence has been advanced that dentinal tubules contain a fluid, the dental lymph.[6] A young tooth, i.e., a recently erupted one, contains more dental lymph than an older one. Also, the physical condition of the tubules varies, depending on the age of the tooth. For instance, the dentin of a first permanent molar of a child of 7 or 8 years readily allows the passage of fluid through its dentinal tubules; i.e., they are open, and such teeth are highly permeable. Figure 1 shows a

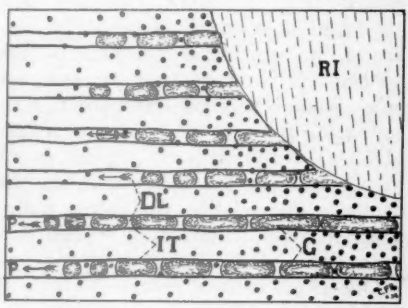


Fig. 3.—Excavation of margin of dentin cavity (size of dentinal tubules grossly exaggerated in relation to rapidly rotating instrument [RI]). Friction causes heat (dots) which expands dental lymph (DL) and forms gas (G). Pressure transmitted particularly by intact tubules (IT) toward pulp (P) causes pain. (Hydrostatic theory of pain transmission.)

section of a bicuspid tooth of a young person the dentin of which is in two different states of permeability. The area marked MD is made up of matured dentin in which the tubules are impermeable; the light dentin (DD) contains dental lymph and is highly permeable. The high permeability has two disadvantages: (a) the pulp is irritated more readily by operative procedures and by certain fillings and (b) the excavation of such teeth is more painful to the patient. The permeability of the teeth is reduced several years after their eruption, owing to (a) the formation of secondary dentin in the pulp chamber and (b) the decomposition of the dental lymph, many of the tubules being thus filled with a gas and dried remnants of the dental lymph (Fig. 1, MD). Evidence that gas forms in dentin is presented in Figure 2, in which various sizes of gas bubbles (G) can be seen in some tubules, while others are transparent, indicating the presence of the dental lymph (DL). This subject is explained in detail in a paper on the metabolism of the dentin.[7] The relation that permeability bears to pulp irritation by fillings has been discussed elsewhere.[8]

One effect of heat on the dentin and the dental lymph from rapid operative technic is shown in Figure 3. A rapidly revolving bur (RI) held in contact with the dentin will develop heat (Fig. 3 [dots]) in this and neighboring areas and, for the moment, seal the dentinal tubules with which the instrument is in contact. The result of this heat is to vaporize the dental lymph (DL), creating pressure, which, in permeable tubules, is transmitted directly toward the pulp (P). Intact tubules (IT), that is, those which do not lead into the cavity, transmit this pressure to an even greater degree because the vaporized lymph cannot escape outward and must therefore exert pressure on the pulp. An attempt was made to demonstrate this reaction grossly by duplicating two of the essential structures of the dentin; i.e., a tubule and an odontoblast. In this model, the brass tube was supposed to represent a dentinal tubule to which was attached a rubber bag, the odontoblast; both being filled with water to represent the dental lymph. Heat applied to the brass tube (representing the dentinal tubule) causes the water (i.e., dental lymph) to expand, then bringing pressure on the rubber bag (odontoblast). When the source of heat is removed, the bag again collapses.* This, then, is one possibility as to how friction heat may cause pain. We do not know whether the pressure transmitted along the tubules can cause harm to the odontoblasts. These cells can expand but slightly, as they are surrounded by a gelatinous substance (intercellular) and enclosed in the rigid walls of the pulp chamber; hence, the cell membrane will not rupture easily. However, the heat generated by speedy operating causes expansion, which results in pain. Besides this, heat may do harm by other means; i.e., by raising the temperature of the tooth, which results in necrosis of the pulp.

Careful operators check the formation of heat by working slowly and cooling the tooth. If carborundum stones or diamond instruments are used, water is sufficient. On the other hand, steel burs require a dry field for effective excavation; hence, only a stream of air can be used for cooling purposes. It is advisable, therefore, that the rapidly revolving bur be held in the same area of the dentin for no more than half a second or less.

A protective factor is present in the pulp which minimizes the danger of heat harming it under normal conditions, in that the blood stream carries away some of the heat, this tending to equalize the temperature. However, the common use of epinephrine in procaine anesthesia reduces greatly the cooling effect of the

*Demonstrated at the reading of the paper by a strip of moving picture film.

blood upon the pulp, because this drug constricts the capillaries and thus reduces the blood flow. This is another reason why the preparation of teeth for extensive operative reconstruction should be performed at even a slower rate than when no anesthesia is employed.

The use of a dentin desensitizer seems to safeguard the pulp against harm during operative procedures better than procaine anesthesia. If the pulp retains its normal sensitivity, as it does with a desensitizer, the dentist must operate slowly, if he does not wish to cause pain. No such protection exists when procaine anesthesia is used, as the entire field is robbed of sensation; hence, the dentist can, and often does, operate so rapidly that friction heat harms the pulp. This difference in action of local anesthetics and obtundents is, I believe, responsible for many apparent failures to operate painlessly under desensitizers.

The question arises: Have we evidence that pulps are really harmed by rapid operating? No statistical analysis has been made of the subject; however, clinical experience shows that abscesses occasionally form on teeth carrying jacket crowns or extensive inlays. The criterion to determine the condition of the pulp is usually only the symptoms of the patient; i.e., pain and abscess formation. It is true that the electric pulp-tester may be of assistance in this connection. This instrument, however, as shown by Dr. Ziskin,[7] is not always reliable, particularly when defining the vitality of teeth carrying bridge abutments. The darkening of such a tooth may on occasion suggest that the pulp has died, but, in the absence of clinical symptoms, the dentist commonly ascribes this condition to the large inlay restoration.

The above discussion indicates that a considerable number of pulps may die as a result of a rapid operative technic, but that they are not regarded as dead because of the absence of clinical symptoms. The reason for this is as follows: Teeth destined for extensive restorations have normal, non-infected pulps. If a rapid operative technic is resorted to, the pulp is cooked sterilely. In the absence of bacteria, this organ becomes mummified and causes no subjective symptoms. It is rare that such a dead pulp becomes infected either by the blood stream or from other sources. When this does occur, an abscess results, and then and only then does the previous death of the pulp become apparent.

Evidence that dead pulps may remain quiescent for a long time is shown by the following case history: A left upper maxillary central incisor in a person 21 years old was subjected to a spark of static electricity. (This was brought about by another person shuffling his feet on a carpet and then touching the tooth.) A slight pulpitis developed for a few days, the tooth becoming darker and darker. The case was kept under observation for twenty-four years. Finally, a slight pericementitis occurred, and when the pulp chamber was opened, the tissue was shown to have disintegrated. This case history suggests that other pulps may die as a result of trauma and yet no clinical symptoms be present.

SUMMARY AND CONCLUSIONS

Rapid operative technic generates heat, which, by expansion of the now established dental lymph, creates pressure on the dental pulp. This may be one mechanism of pain transmission and harmful to this organ. Another source of harm is the direct effect of heat on the pulp, which may result in necrosis of this organ without symptoms. The exclusion of sensation by anesthesia allows the dentist to work rapidly. Clinical observations suggest that the heat generated in this manner is responsible for the death of many previously normal pulps. More emphasis should therefore be placed on the frequent warning that *in order to prevent harming dental pulps, drilling or grinding of teeth under anesthesia*

should be performed at even a slower rate of speed than that used without anesthesia.

BIBLIOGRAPHY

1. Hartman, L. L.: Operative Dentistry Failures Due to Improper Use of Anesthesia. *Tr. Am. D. Soc. Europe,* 1937, p. 22.

2. Pain and Its Prevention. Editorial. J.A.D.A., 25:792-793, May 1938.

3. Bronner, F. J.: Effects on Pulp by Certain Operative Procedures. *D. Cosmos,* 74: 535-537, June 1932.

4. Hudack, Stephen, and McMasters, P. D.: Gradient of Permeability of Skin Vessels as Influenced by Heat, Cold and Light. *J. Exper. Med.,* 55:431-439, March 1932.

5. Lewis, T.: Blood Vessels of Human Skin and Their Responses. London: Shaw and Sons, Ltd., 1926, p. 66.

6. Bodecker, C. F.: Concerning "Vitality" of Calcified Dental Tissues. *J. D. Res.,* 16: 463-475, December 1937.

7. Bodecker, C. F., and Applebaum, Edmund: Metabolism of Dentin; Relation to Dental Caries and to Treatment of Sensitive Teeth. *D. Cosmos,* 73:995-1009, October 1931.

8. Bodecker, C. F., and Applebaum, Edmund: Effect of Filling Materials upon Teeth. *D. Cosmos,* 72:1002-1014, October 1930.

9. Ziskin, D. E.: Observations on Electrical Pulp Testing. *J. D. Res.,* 17:79-89, April 1938.

630 West One Hundred Sixty-Eighth Street.

TREATMENT OF INITIAL CARIES IN THE ANTERIOR TEETH WITH GOLD FOIL

By Ernest M. Jones, D.D.S., Los Angeles, Calif.

In the consideration of his dental health, the average American maintains a surprisingly logical philosophy which tends to guide him along beneficial roads unless he is misdirected by one for whose opinion and advice he has the utmost respect. Left to his own judgment, this average American, I am certain, is far more vitally interested in the longevity and fidelity of his dental service than in the debatable insecurity of esthetic concepts. It is with this thought that I direct this presentation to the majority of our profession, who I sincerely believe may better administer to the rank and file of their clientele by intelligent application and honest endeavor in the filling and restoration of teeth.

Read before Section on Operative Dentistry, Materia Medica and Therapeutics at the Eightieth Annual Session of the American Dental Association, St. Louis, Mo., October 26, 1938.

The term "filling" is employed in specific reference to the silicate cements, which, for the present at least, cannot be classified as restorative agents and the temporary esthetic qualities of which are not worthy of consideration.

I have purposely left open an avenue of exemption for those comparatively few dentists who have made themselves proficient in the art of baked porcelain. That they accupy a position of first rank in the field of esthetics is undisputed. It is regrettable that the fine inlays produced by these artists are dependent upon current cements for seal, retention and finish line.

The acknowledged aversion to the placement of gold foil in the anterior teeth arises from two sources, objective and subjective. In the former instance, we find that the dental profession, through failure to acquaint themselves with the possibilities and advantages of gold foil, have created in the mind of the laity

a definite antipathy cloaked in the shining but treacherous garb of esthetics. Secondly, the dentist himself has been influenced by the all too familiar bugaboos of application of the rubber dam, malleting of the foil and the implied grotesque appearance of gold restorations. Consequently, we find the conference between dentist and patient terminating in a mutual dislike for this manner of restoration. That this feeling is general was borne out in a recent conversation which I held with a visiting dentist who informed me that "of course, we ethical men from our state do not place gold foil in the anterior teeth."

Obviously, such standards are not universal, but they demonstrate the humble

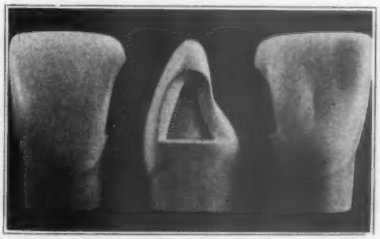


Fig. 1.—Typical Class III preparation; outline form following lobes of teeth.

position occupied by gold-foil operations in the eyes of many otherwise progressive dentists.

In presenting the technics of the topical operations to those who are advocates of this method, the subsequent planning and procedure outline may give origin to certain differences of opinion, which may be of such import as to result in invaluable contributions and in further appreciation of the possibilities in results to be obtained.

In the treatment of initial caries, many ideas and innovations have been developed to alleviate the necessity of restorations. These offerings are to be commended and encouraged, and it is hoped that the future may offer us much that is worthy, but, at present, when we encounter those areas which present a dissolution of the cementing substance of the enamel and a breaking down of the enamel rods, resulting in a loss of contour of the affected surfaces, the logical procedure is to resort to instrumentation and a restoration of the involved tissue with a suitable material.

DIAGNOSIS OF INITIAL CARIES

Of primary importance, then, is the diagnosis of initial caries in a given area. This is often ventured by the use of bitewing x-ray pictures. That these are an aid is not disputed, but it has been my experience that there are occasions when these pictures may not be indicative of the nature and extent of the

Fig. 2.—Square type tooth form, typifying extended contact areas and flat surfaces.

caries which may be present. I am convinced that a more thorough and satisfactory examination can be made by isolating the teeth in question with the aid of the rubber dam, the probing with a fine explorer being supplemented by the application of separators if they are necessary. Such a procedure insures a definite comprehension as to both the nature and the extent of the diseased area.

In classifying the various stages of decomposition revealed by the diagnosis, Julio Endelman advocates the utilization of the nomenclature of the European pathologists.

This classification is briefly as follows:

I. A definite break in the enamel, but with no destruction of the dentin.

II. Destruction of the enamel, with an initial involvement of the dentin.

III. Involvement of the dentin calling for a protective agent.

IV. Pulp involvement.

In consideration of this classification of caries, relative to the placement of gold foil, we find that in dealing with either Class I or Class II, the surface involvement or the depth of the decay would not in any manner preclude the establishment of a cavity in its ideal form, with adequate extension for prevention of recurrent decay.

It is the thesis of this paper, in consideration of the treatment of initial caries in the anterior teeth, to make an earnest appeal for permanent restoration when the opportunity presents itself; to insistently urge the abandonment of inferior filling materials, which not only cease to function after a limited time, but also become a further liability in so far as, through their very insufficiencies, they so augment decomposition as to render later operations more difficult and conditions of operating more unfavorable. Furthermore, repeated efforts of a similar nature can but lead to permanent failure, with the automatic necessity for a prosthetic appliance, which the prosthetists are ever contending with and the esthetic values of which are questionable indeed.

Fig. 3.—Restoration of mesial and distal surfaces of central incisors in square type tooth form; showing extension necessary owing to flattened surfaces and contact areas.

Fig. 4.—Ovoid type tooth form, typifying minimum contact areas and rounded surfaces.

It is not essential that we enter here into a lengthy discourse on the relative merits of filling materials. It is sufficient to state that in initial caries, the opportunity is afforded to restore the area in gold foil. The very fact that gold foil is, as yet, the finest agent devised by man to restore to normal function a portion of the human tooth rendered inadequate by disease, together with knowledge that such an operation requires the least loss of tooth structure to obtain the desired end result, serves as the basis for this belief. To further substantiate this position I shall quote from the late Arthur D. Black, who devoted the greater part of his life to the advancement of operative dentistry. In reference to Class III operations, Dr. Black states:

> Except for neglected decays, these cavities may be prepared for gold restorations with less sacrifice of tooth structure than for either porcelain or gold inlays, and gold foil restorations are likely to last longer. . . . This is the only material which in the hands of the large percentage of operators has satisfied the requirements for permanent operations in cavities of this class.

OUTLINE FORM AN ESTHETIC CONSIDERATION

We discover, then, that in advocating the use of gold foil for restorations in the anterior teeth, the predominant source of controversy would appear to be the question of esthetics, as the fitness of the material as a restorative agent for lost tooth structure is quite universally accepted. In advocating the restoration of these areas by gold foil, the three main divisions as to typal forms of the teeth

will be considered: square, tapering and ovoid. That each of these principal typal forms presents three principal labial surface forms, ovoid, flat and concave, will not enter into consideration, as these surface forms do not materially affect the mesial and distal surface angles of the teeth to the extent that a line of distinction must be necessarily drawn.

The detection of initial caries in the proximal surfaces of the upper anterior teeth, and the treatment of these cavities with relation to the forms presented and their relationship in the arch, affords an opportunity of restoring these teeth to a long term of usefulness. A service is rendered that should not reflect on the esthetic sensibilities of either the donor or the recipient to the point of provoking embarrassment.

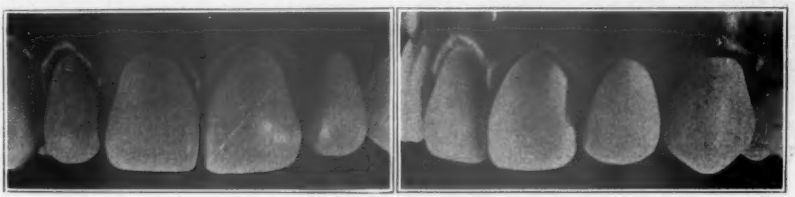


Fig. 5.—Restoration of distal aspect of central incisors in ovoid type tooth form; front and side labial view.

In consideration of the forms of the teeth and in presenting their anatomic characteristics that may be taken advantage of in the outlining of the preparations, a quotation from W. I. Ferrier's writings on gold foil is given, with its application as illustrating the advantages of this type of preparation over other types commonly known and practiced. This great work so ably presented by Dr. Ferrier should receive added encouragement and endorsement.

The labial outline form presents a straight line for the extent of its gingival two-thirds to such a point that its labiogingival angle is placed under the free gingiva, if this be in normal relation. On the incisal third it presents a curve that blends in with this line symmetrically. This outline when completed, closely approaches the mesiolabial angle of the tooth and its position in the arch. Here, it will reflect the light and not appear as a dark stain if it is held in too closely to the center of the tooth. Here it parallels and is in conformity with the lobe of the tooth which is the only distinctive marking adjacent. It is in pleasing harmony with the size and shape of the tooth and is not nearly so conspicuous as one might think before the completion of the operation.

In the application of this outline (Fig. 1) to the labial surfaces of the several forms of the teeth and their anatomic characteristics, in consideration of initial caries being present, the advantages that may be derived will first be considered in the square type tooth.

This form of tooth (Fig. 2) is the most difficult to handle. The proximal surfaces as a rule are broad and flat, the contact being well to the incisal edge, in instances contacting the full extent of the surface from the incisal tip, to include a portion of the gingival third of the surface. The early detection of caries in these surfaces is essential if the incisal angle of the tooth is to be preserved. The surfaces so presented justify failure to include in the preparation the full contact area at the incisal angle, if not involved. The maintenance of the incisal angle is justified whenever possible, and dependent only on the conditions present.

The labial extension (Fig. 3), due to the flattened proximal surfaces, should, in order that the completed restoration

may meet the full requirements of restoring the surface, reflect harmony, the contrast being as negligible as possible. The labial-proximal angle, being, as it is, more acute than that presented in other forms of teeth, requires that the labial outline more nearly approach the height of the labial-proximal angle of the tooth and that the symmetrical curve which forms the incisal portion of the outline be less abrupt.

The tapering and ovoid typal forms of the teeth present a curvature of surface and a variety of incisive angle forms which, if taken advantage of in restoring these initial lesions of decay with gold foil, should meet the approval of all save the ultra-discriminating, who would not tolerate gold under any conditions. (Fig. 4.) The proximal surfaces

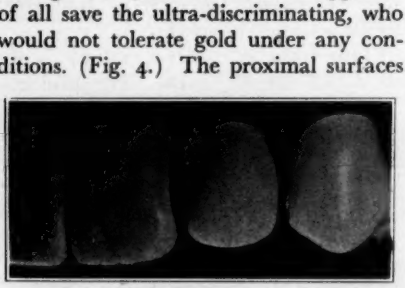


Fig. 6.—Restoration of mesial aspect of cuspid and distal aspect of lateral incisor. Removal of the proximal curvatures permits conservation in cavity preparation.

of these teeth have well-contoured surfaces with definite contact areas. Especially is this true of the distal surfaces on these teeth and the mesial surfaces of the cuspids. These surface markings present features which, from an esthetic viewpoint, may be employed to advantage in the construction of the cavity and, at the same time, adhere to the approved principle of cavity preparation to receive gold foil fillings.

Specific cases will best serve for illustrative purposes. On the distal surface of an upper ovoid type central incisor (Fig. 5), the location of the initial decayed area affords an opportunity for the restoration of the surface by removal of the contact area, leaving a well-supported incisal angle. The labial wall is prepared to harmonize with the lobe of the tooth and terminates in a definite angle with the gingival wall, beneath the normal free gingiva.

The construction of such an outline presents the features of affording access for the placement of foil in the labial-axial-gingival point angle without added extension labially. The labial-gingival angle of the restoration is placed in an immune area by including that surface of the tooth which may present a gingival involvement; which, at the same time, affords the opportunity of joining with a gingival restoration should the occasion arise. In this manner, an esthetic synchronization of the restored area with the anatomic structure of the original tissue is obtained.

Often on the distal surfaces of lateral incisors, and invariably on the mesial and distal surfaces of the cuspids, an angle is formed by the union of the proximal surface with the incisal surface of the tooth. (Fig. 6.) The angle thus formed scribes a convenient arc for the outlining of the preparation, presenting features of conservation of tooth structure, convenience for the placement of the foil and a permanent restoration of the surface, together with the minimum display of gold.

By the nature of their anatomic structure, the mesial surfaces of the upper anterior teeth acquire a prominence not common to the distal areas. (Fig. 7.) To the degree that these surfaces are apparent to light and vision, the advantages for an esthetic gold foil restoration on the distal surface are not present. On the mesial surface, the labial extension is confined as closely as is possible without affecting in the least the conditions of proper cavity preparation nor impairing the harmony with the original tissue.

The lingual and gingival wall extension of these labially described preparations are constructed in harmony with

the labial extension, with a minimum of extension to insure the conservation of this portion of the tooth, where caries rarely recurs. (Fig. 8.)

The destruction of tooth structure for convenience should be avoided when at all possible. A technic to aid in the restoration of these surfaces has been developed, calling for the application of the separator where necessary, and this is deemed far more advisable than the removal of tooth structure for convenience only.

Initial caries appearing during adolescence affords an occasion for consideration as to the correct and advisable manner in which these areas should be handled. There are so many conflicting circumstances to cope with that I do not venture to subscribe to a rule. The welfare of the individual tooth must ever be of vital concern. The insertion of gold foil in these areas during this period will necessarily have to be dependent on the temperament and physical status of the patient, together with the ability of the operator. It is surprising how early these cases can be taken care of on the detection of initial caries, when a satisfactory technic is employed and when the tooth structure is so respected. A recent publication by an authority in this work describes the restoration in gold foil of the distal surface of a lower cuspid and the mesial surface of a lower first bicuspid in a child 11 years of age.

To portray the advantages of these conveniently established outlines where initial caries is present, it might be well to draw a comparison with the outline forms that are observed from time to time. From such an analysis, certain conclusions can be reached as to the relative value of the one presented in meeting the requirements of restoring the given surface area of the tooth, together with an esthetic consideration which may play a part, as a deciding factor, in the selection of the material to be used.

These comparisons are not drawn with the thought of condemnation or criticism, but it is rather the intention to offer suggestions to better serve the purpose intended and, at the same time, to regard the esthetic approach, which has so long served as a focal point for attacks by the critics of this type of work. Furthermore, it is hoped that an added interest in gold foil operations may be created, especially when favorable conditions are present and the finest medium of restoring lost tooth structure is within our grasp. In the past as in the present, men who work with gold foil have had the welfare of their clientele at heart and are sincere in intent and purpose.

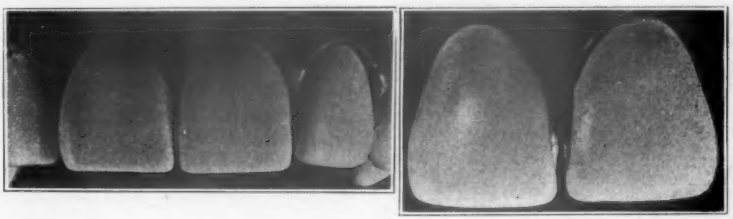


Fig. 7.—Restoration of mesial surface.

For convenience, the outlines observed may be described as either presenting a curve on the labial surface, or as those that are prepared parallel to the long axis of the tooth. It is not the contention that the manner of outlining these cavities has not fulfilled the requirements of preserving the area involved, but rather that they are not constructed to harmonize with that surface. A comparison of

this is offered by way of illustration in the belief that such a manner of outlining may aid in the acceptance of these operations. (Fig. 9.)

The surfaces just described have been treated in such a manner as to meet the full requirements of extension for prevention, as far as the surfaces presented are concerned. If in those cases in which ideal conditions for the outlining of cavity preparation are not available, owing to extensive caries or failure on the part of some previous operation, the operator is desirous of making a gold foil restoration, the extension of these walls following out as closely as possible the same detail, in forming the labial wall, will be found to serve as a material aid in placing the foil and will more nearly harmonize with the tooth structure. (Figs. 10 and 11.)

Fig. 8.—Lingual views. Maximum extension is necessary in cases of initial caries.

Quite apropos of this is an incident which occurred in a professional group when one of the operators removed a silicate cement filling. The cavity thus exposed assumed the appearance of being very extensive, yet, when the gold foil restoration was completed, dentist and patient agreed that the present filling had a more pleasing and less conspicuous appearance than its predecessor. In fact, a better result was secured than could have been anticipated.

Diligently striving to maintain throughout a conservative attitude toward the use of gold foil, I wish to call your attention now to that operation which is known as the invisible Class III gold foil filling. The advancing years have seen many attempts at this operation either by intention or by accident. Whether there was a definite purpose at the time is a matter of conjecture, but undoubtedly many cases have been viewed as praiseworthy in consideration of the number of years that so slight an operation has preserved the surface of the tooth. These are anomalies, and while they should always be considered as the exception rather than the rule, a technic of procedure has been established. This operation, however, should be carefully guarded and confined to its specific indications. A promiscuous use of this type of restoration could readily arouse an enthusiasm in patient and operator alike that would tend to elevate the operation to the point where it would become the rule rather than the exception; and, naturally, much harm could come to the proved and well-established work of gold foil operators who demand that their restorations shall meet the full requirements of the fundamental principles of cavity preparation.

The indications and advantages of these operations are worthy of comment. The indications should be governed by environment, and that environment be adjudged by a favorable prognosis as to that particular area of the tooth. The advantages derived are the minimum of tooth involvement and the placement of gold foil so as to avoid any appearance of gold from a labial view. If the gold is at all apparent, the esthetic advantage is lost. If such treatment of these areas is classified as a temporary measure, it is a far better one, in that respect, than could reasonably be expected with any other available material. The cavity preparation is made from a lingual approach. The labial wall is left standing and the gold foil is malleted from the lingual aspect. In order to cover the labial wall, a small cylinder of non-cohesive foil is placed along the labial wall, the remaining portion of the filling process being ac-

complished with cohesive foil. As previously said, conditions are favorable where the decay is more pronounced, involving the lingual plate of enamel, and where the tooth would have considerable bulk labiolingually. These operations may be carried out on the proximal surfaces of all the upper anterior teeth, when the environmental and structural conditions are favorable.

TREATMENT OF LOWER ANTERIOR TEETH

Initial caries in the proximal surfaces of the lower anterior teeth present ideal conditions for restoration of the surface with gold foil. (Fig. 13.) The esthetic approach is not of so great importance as in treatment of the maxillary anterior teeth. This is obviously due to the protection afforded by the lips, the mobility of the mandible and the minute details of the preparation. With the question of esthetics so minimized, there remains but the restoration of the surfaces with an indestructible material. Because of the immunity of the lingual surfaces, the preparation of the cavity and the restoring of the diseased area are very much simplified.

In the preparation of the cavity, the lingual wall is left standing and the labial outline established in conformity with the lobe of the tooth. As these areas seldom manifest, to a great extent, the superficial etchings of decay that are observed on the other surfaces of the tooth, the limits of the cavity may well be confined to the area involved.

Often these conditions appear in pairs, on the mesial surface of one tooth and the distal surface of a neighboring tooth. Such a complication is met by applying a separator, and with a slight amount of separation, the two operations can be completed at the same appointment. This preparation and application is of particular value in restoring the distal surface of the lower cuspids. The difficulty in restoring these surfaces is readily discernible when we consider the variety of materials—cements, amalgams, inlays—used in an effort to solve the problem. Time itself has been the critic of these operations and their feeble attempts to preserve tooth structure. Yet, by the

Fig. 9.—Circular and long axis outline forms.

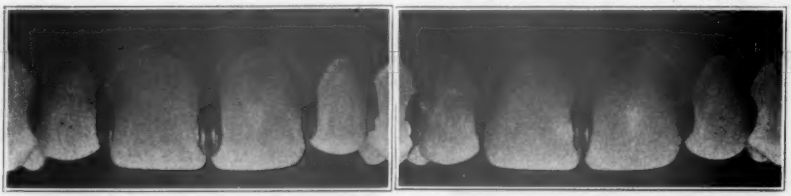


Fig. 10.—One type of cavity outline form. Compare esthetic values with those of types shown in Figure 11.

placement of gold foil, it is possible not only to secure a permanent restoration, but also with less loss of tooth structure, and to have a finished product which literally defies detection.

Class IV restorations in both the upper and lower anterior teeth can hardly come under the classification of initial caries. The loss of the angle of the tooth is usually superseded by a previous involvement unless it is caused by trauma. Gold foil may not be selected as the restorative agent here, owing to the sacrifice of tooth structure that would be necessary in the

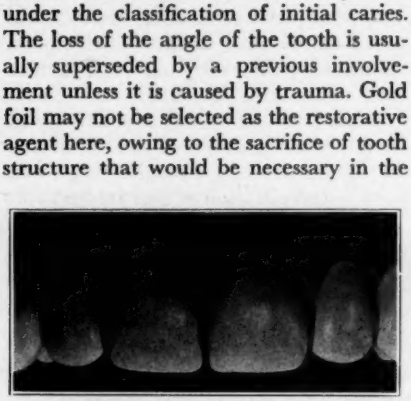


Fig. 11.—Types of cavity outline form. Compare esthetic values with those of type shown in Figure 10.

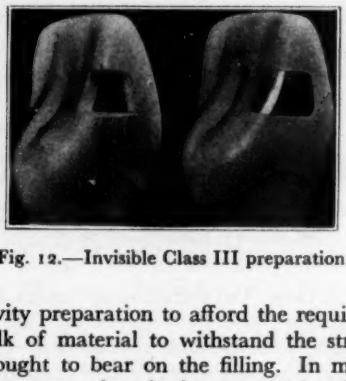


Fig. 12.—Invisible Class III preparation.

cavity preparation to afford the required bulk of material to withstand the stress brought to bear on the filling. In most cases, even though the area of involvement is the minimum, the use of a pin inlay of hard gold is deemed to be the logical procedure and, as a rule, will prove to be more valuable in the conservation of tooth structure, and in meeting the requirements necessitated in the restoration of these multiple surface areas.

The decay appearing on the gingival third surface of the teeth shows an inclination to spread rather than to penetrate. The treatment of these areas of initial caries requires that they be extended mesially and distally to the angles of the tooth, a part of which is followed and included in the preparation where there are areas susceptible to decay. The typical preparation presents a box-form cavity together with the variation of atypical forms which is adequate to provide for the restoring of these surfaces.

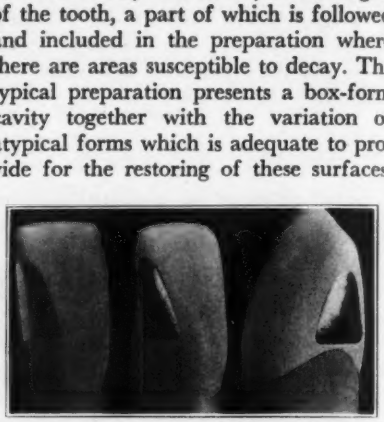


Fig. 13.—Typical lower anterior preparation and restoration; showing preservation of lingual wall.

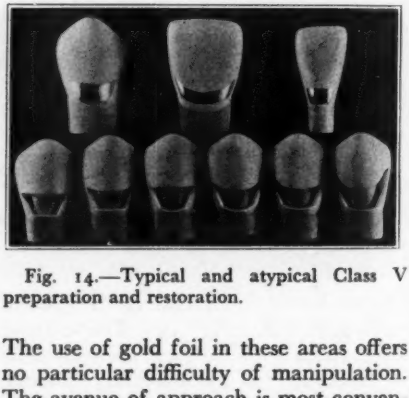


Fig. 14.—Typical and atypical Class V preparation and restoration.

The use of gold foil in these areas offers no particular difficulty of manipulation. The avenue of approach is most convenient, and its surface is in plain view and easy of access through the application of the rubber dam and the adjusting of a cervical clamp.

The demands for the successful contouring of these surfaces are dependent, to a large degree, on the nature of the finish line. This is especially true in ref-

erence to the gingival wall which circumstances demand shall be placed beneath the free border of the gingival tissue. Hence, the necessity of selecting a material for which the tissues have tolerance, thus insuring the continued health of the supporting tissue. By selecting gold foil, we eliminate the use of cement and cement margins, which are irritating to the tissues, and, at the same time, secure a perfect margin together with the desired surface contour and finish, all of which may be gained at the one operation.

The esthetic consideration is of minor importance in the restoration of these areas of initial caries. In most mouths, such fillings are completely or partially hidden by the lips. On the whole, I know of no other class of cavity, in all of its variations, which lends itself so advantageously to the use of gold foil.

CONCLUSION

As I approached this subject, I was fully cognizant of the apparent boldness of the unconventional technics which I intended to present. I was, however, sustained and encouraged by a sincere confidence which had been won through years of personal application and observation. While we all recognize the ancient truism that there is nothing new under the sun, it is often well to have some of the finer and faithful things brought before us in review lest, because of their very closeness, we are apt to overlook their inherent values when dazzled by the brightness of some novel and much-publicized panacea. Gold foil long has been established as an excellent restorative agent, and if any renewed interest in its use is attained, such time and effort as were necessitated in the preparation of this treatise have not been ill spent.

To summarize the ideas here submitted and the virtues claimed for gold foil restorations:

1. They are the most practical means of restoring tooth structure destroyed by initial caries.

2. For the majority, the advantages far outnumber the many feeble and questionable esthetic objections.

3. Tolerance of the oral tissues, in its essence, insures a conservation of the remaining tooth structure.

4. There is facility of access.

5. Strength and permanency are assured as against the weakness and insecurity of other material.

6. An esthetic quality is derived from the permanent nature of the restoration and its complete conformity to the tooth structure.

Surely a noteworthy list of attributes, even the most skeptical will admit.

If dentistry is to survive as a healing art, the sooner we adopt the principle that it is better to conserve than replace, the sooner will we be deserving of that confidence which is the desire of every right-thinking professional man.

122 East Sixteenth Street.

USE OF INTRA-ORAL JAW RELATION WAX RECORDS IN COMPLETE DENTURE PROSTHESIS

By WALTER H. WRIGHT, D.D.S., Ph.D., Pittsburgh, Pa.

THE use of intra-oral jaw relation wax records in complete denture prosthesis is perhaps one of the oldest practices in prosthetic dentistry. Before the advent of modern articulators, beeswax was used in recording such jaw relations as were then required in the making of complete dentures. In 1901, Christensen,[1] of Copenhagen, described his articulator and an intra-oral method of making jaw relation wax records by which it could be adjusted. That this idea was not entirely original is confirmed in Christensen's paper, which refers to the previous work of Fick,[2] who, by a mechanical device that simulated the jaws, was able to grind two plaster blocks against each other, thus producing the characteristic curvature of the natural teeth. This device was later demonstrated by Christensen. (Fig. 1.)

Christensen made practical use of Fick's idea by having the edentulous patient grind-in wax rims (Fig. 2), until they were balanced in the mouth. He understood the problem of balanced occlusion as related to condyle guidance and the compensating curve of the teeth as shown by his drawings. (Fig. 3.)

Christensen's most important contribution to the present practice of denture prosthesis is the protrusive relation wax record. Figure 4, one of his drawings, shows an articulator adjusted by this method. It is to be regretted that Christensen did not use vulcanite denture bases in his experimental study, as had been done in 1897 by Walker,[3] who studied the extra-oral method of articulator adjustment.

Before describing the method by which intra-oral wax records are made, it is advisable to consider briefly the principles upon which the intra-oral method of recording jaw relations is founded. The intra-oral method records jaw relations and displacements, but it does not record jaw movements, as clearly shown by Hanau.[4] Since intra-oral records are not intended to record jaw movements, an articulator adjusted by this method cannot be regarded as reproducing the jaw movements of the patient. Instead, it records positional jaw relations which, at the teeth, may be identical with occlusal relations in the mouth, but, at the condyle guidance, would rarely if ever be identical with the condyle path of the patient, owing to the resilient and like effect as explained by Hanau.[4]

Prior to the work of Hanau, it was generally accepted that an articulator truly recorded mandibular point movements of the patient. In other words, the articulator was thought to reproduce movements which in magnitude and direction were identical with the movements of analogous mandibular points. The writings of Walker, Christensen, Gysi and others show that this error was common to researchers in this field.

A careful study of the work of Hanau makes it clear that intra-oral relation records involve considerations other than

Read before the Section on Full Denture Prosthesis at the Eightieth Annual Session of the American Dental Association, St. Louis, Mo., October 26, 1938.

the position of the jaws. Of the many conditions that affect the accuracy of intra-oral relation records, I shall mention but four: (1) the resilient reaction of the supporting tissues, (2) the nature of the saliva, (3) the fit of the denture-bases and (4) the pressure applied in making the records.

1. Interposed between the edentulous jaw and the prosthetic denture is the mucous membrane, which may vary in thickness and physical quality. When this membrane is thin and resistant, a well-fitting denture is firmly supported and stabilized, and thus the resilient effect on the intra-oral records and subsequent articulator adjustments is minimized. How-

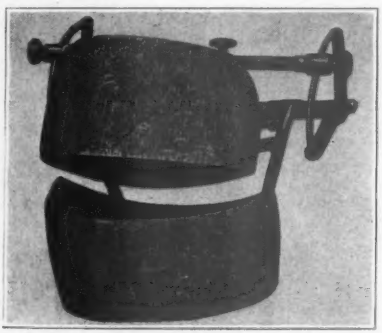


Fig. 1.—Christensen articulator with plaster blocks ground in to accommodate articulator guidances.

ever, when resilient, especially flabby, tissue is present, the articulator adjusted with intra-oral records may deviate an almost unbelievable amount from all analogous mandibular points except the occlusal surfaces of the teeth, where they may vary only slightly.

In the light of Hanau's work, we now understand that articulator point movements are equivalent to analogous mandibular points and not identical as previously maintained.

2. The saliva between the denture bases and the supporting mucosa may likewise influence the intra-oral record. When the saliva is viscid and thick, it may act as a displacing agent under the denture bases and thus affect the record just as does the resilient mucosa.

3. The fit (i.e., the adaptation, stability and retention) of the denture bases has been and now is the major stumbling block in making intra-oral records. It is imperative that the denture bases possess the most perfect adaptation, stability and retention attainable. Without this primary prerequisite, each succeeding step embodies and magnifies the original error, leading ultimately to failure. Further, the old adage relating to the danger of changing horses in midstream applies with equal force to denture bases used in making relation records. The same denture base, whether of vulcanite or metal, should be used throughout the construction of a complete restoration.

Fig. 2.—Wax rims showing curvature of occlusal surfaces after being ground in in mouth.

Unless subsequent records are made upon identical, or nearly identical, denture bases, the resulting records will not be consistent. It is obvious that the use of wax, shellac, compound and other materials is not recommended for denture bases upon which intra-oral relation records are to be made. Likewise, owing to the fact that a change is likely to occur, it is recommended that impressions should not be used as bases for intra-oral records.

4. Now, we come to the subject of pressure upon intra-oral records, a problem which at present is being ignored by many operators. If dentures were supported by bone instead of by the mucous membrane, pressure exerted by the

muscles would have little or no displacing effect on the dentures. But denture bases are supported by soft tissues capable of being displaced by pressure, and this pressure causes the intrusion of the bases into the tissues, thus changing their position in relation to the mandible or maxillae upon which they rest. As it is impossible to have a patient apply the same amount of pressure on each subsequent record, it is logical and mechanically correct to make preliminary records without pressure, or as nearly as possible with a pressure of zero. Such records may be duplicated from time to time and thus irrelevant considerations which otherwise may arise be avoided. Since no articulator can be simultaneously adjusted for pressure and no pressure records, it is better to start with an unstrained relation, used during swallowing and speech, and later to correct the occlusion for those strained relations required in mastication, than to start with strained relations, with the prospect of being unable to obtain unstrained balanced occlusion. Masticatory pressure in relation to dentures will again be mentioned toward the end of this paper.

With these fundamental considerations, we shall pass to the technical procedures involved in making intra-oral relation records.

VULCANITE DENTURE BASES

In the technic which follows, vulcanite or similar denture bases are used. These bases, which are vulcanized upon acceptable artificial stone casts, must meet the following requirements: 1. They must meet the physiologic requirements of the supporting tissues during function. 2. They must have the greatest degree of retention and stability consistent with the physiologic tolerance of the mucosa. In brief, denture bases should possess the same retention and stability that would be expected of the finished dentures. Unless they meet these rigid requirements with regard to seating surfaces and denture borders, the difference in size and shape, and the magnitude and distribution of the resilient tissues, will influence the relation records and lead to different articulator adjustments. Failure to use permanent denture bases has resulted in the most irrelevant and disconcerting errors, not only in the hands of practition-

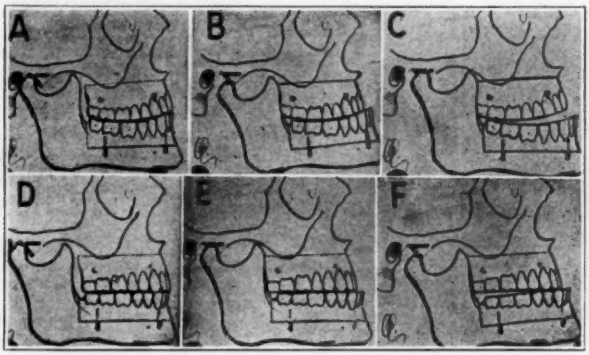


Fig. 3.—Christensen's drawings: A, skull with compensating curve and mandible in centric relation. B, skull with compensating curve and steep condyle path resulting in balanced protrusive occlusion. C, skull with compensating curve and flat condyle path resulting in unbalanced protrusive occlusion. D, skull with flat occlusal plane and mandible in centric relation. E, skull with flat occlusal plane and flat condyle path, resulting in balanced protrusive occlusion. F, skull with flat occlusal plane and steep condyle path, resulting in unbalanced protrusive occlusion.

ers, but also in the hands of those who undertook to investigate Hanau's claims, while disregarding some of the most important technical requirements of Hanau.

DENTURE BASES TESTED IN THE MOUTH

Both maxillary and mandibular vulcanite denture bases (Fig. 5), having been polished, are tried in the mouth and tested for retention, stability, proper extension of borders and comfort to the patient, and finally are trimmed in the tuberosity regions, if the bases should oppose each other prematurely when the jaws are in approximately the correct relation. If the bases are found acceptable in these respects, they are approved for the subsequent restoration. If not, they are used as trays in making new impressions.

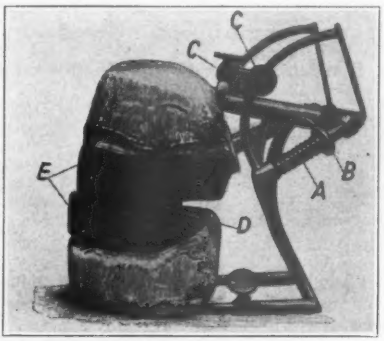


Fig. 4.—Christensen articulator adjusted by protrusive jaw relation wax record.

PREPARING THE MAXILLARY CONTOUR MODEL

A rod of occlusion rim wax is softened, adapted and sealed to the maxillary denture base, which is then tested in the mouth, contoured to the proper fullness and trimmed to the required length so as to meet the esthetic and mechanical requirements of the proposed maxillary denture.

RECORDING THE GLENOMAXILLARY RELATION

The glenomaxillary relation is recorded by use of the facebow and transferred with the maxillary denture base to the articulator, which has been tentatively adjusted to receive the mounting. Prior to mounting, it is necessary to eliminate undercuts in the denture base, if present, by filling in with softened wax or modeling clay. The maxillary denture base is now attached to the upper articulator member with plaster. After the denture base has been mounted, the facebow assemblage is carried back to the patient to determine whether the original facebow adjustment has been altered during mounting. If the facebow condyle rods coincide with the markings on the face, the mounting is approved; if not, a correct mounting must be made.

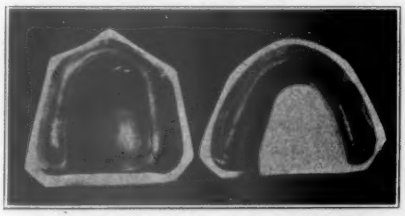


Fig. 5.—Vulcanite denture bases ready to be tested in mouth.

ESTABLISHING THE MANDIBULAR DENTURE SPACE

The maxillary denture base with its wax relation model is now prepared for subsequent records by the carving of grooves, extending from cuspid to second molar teeth, in both posterior regions, and a groove in the anterior region of its occlusal surface, as shown in Figure 6. These grooves provide interlocking of the subsequent jaw relation records so that they may be accurately reassembled after they have been removed from the mouth. The relation model is dried and talcum powder is

brushed onto its occlusal surface to prevent adhesion of the subsequent records. The maxillary denture base assemblage is then chilled and placed in the mouth.

The mandibular denture base is now prepared by sealing a wedge-shaped piece of softened black carding wax on the incisal region. (Fig. 7.) This black wax wedge should be higher than the ultimate denture space. After the black wax has been softened in warm water, by inverting the base to which it is fastened, the mandibular denture base with the wax wedge is inserted in the patient's mouth.

The patient is instructed to close slowly and intermittently upon the softened black wax until he feels that the intermaxillary relation is natural and

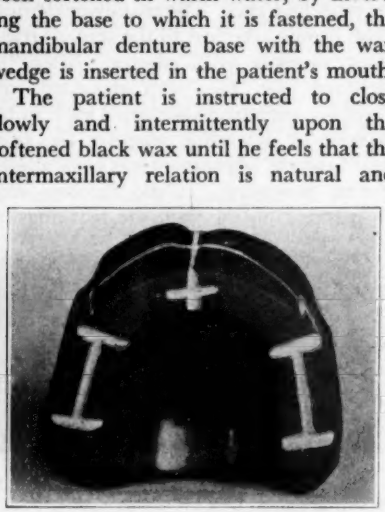


Fig. 6.—Maxillary denture base with wax contour model, showing labial markings and grooves cut into occlusal surface.

comfortable. Prior to making this record, the patient may be instructed regarding the proper intermaxillary space so that, with the aid of a hand mirror and several trial records, the proper intermaxillary space may be accurately determined. Difficulties may arise with patients who have had unsatisfactory denture experience or a decrease in intermaxillary space before their own teeth were extracted. It may aid the patient to suggest that when the proper space has been determined, he should feel capable of exerting maximum biting pressure, provided teeth are present. Finally, after several trials, the operator secures an intermaxillary relation which is both comfortable to the patient and acceptable in regard to the esthetic and mechanical requirements of the proposed dentures.

The height of each black wax record is measured with a caliper, one point of which rests inside the denture base while the other rests upon the occlusal surface of the black wax record. (Fig. 8.) This vertical measurement will indicate whether sufficient space has been provided to accommodate the desired lower teeth. Finally, the length of the patient's face, as restored by this intermaxillary record, may be compared with photographs made before the teeth were extracted.

PHOTOGRAPHIC AIDS IN REESTABLISHING THE VERTICAL FACIAL DIMENSION

It has been found helpful while estab-

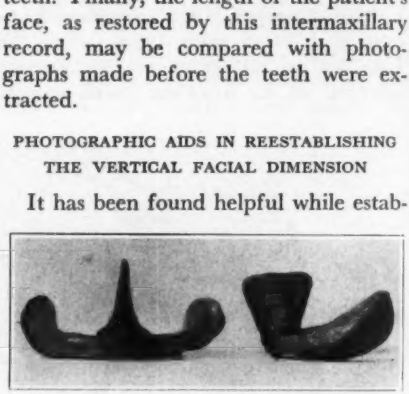


Fig. 7.—Mandibular denture base with black wax wedge. Left, anterior view. Right, lateral view.

lishing the vertical dimension of the intermaxillary space to use preextraction records, or lacking these, to make use of valuable measurements obtainable from old photographs of the patient. Patients invariably have photographs which were made before the teeth were extracted. Of these, a full-face sharply focused photograph of any size, but preferably large, is selected and is measured as follows: (1) the interpupillary distance, the distance between the center of the pupil of the right and left eye, and (2) the brow-chin distance, the distance from the top of the eyebrows to the base of the chin. After recording these measurements of the photograph, the operator returns to the patient and measures the

interpupillary distance with a millimeter ruler, or with an improvised measuring device made by filling the openings in the handles of a pair of shears with black carding wax. A pinhole is made in the center of each piece of black wax. Through these openings, the patient views a distant object, meanwhile opening and closing the shears until the object is viewed with both eyes through a single circle of light, as with a pair of field glasses. (Fig. 9.)

With these three measurements, it is now possible to determine, with acceptable accuracy, the brow-chin distance. The formula from which this measurement is derived and an example of actual measurements are shown herewith.

By this formula, the brow-chin distance (before the teeth were extracted) was found to be 120 mm.

Interpupillary distance of photograph	:	Patient's interpupillary distance	: :	Brow-chin distance of photograph	:	X (Patient's brow-chin distance)
6	:	60	: :	12	:	X

6X equals 720
X equals 120

Returning to the patient, the operator inserts the denture bases with wax rims and intermaxillary black wax record and determines the brow-chin distance with a millimeter ruler. Thus, the original brow-chin distance, obtained by use of the formula, may be compared with the present brow-chin distance, with the denture bases and wax rims in the mouth. If the original and the restored brow-chin measurements are not the same, a compromise may be made in favor of the most desirable intermaxillary dimension and facial esthetics.

INSTRUCTING THE PATIENT PRIOR TO RECORDING CENTRIC JAW RELATION

Prior to recording centric relation, it is advisable to instruct the patient in the several jaw movements which start from and terminate in centric jaw relation. Accordingly, the maxillary base with the occlusion rim and the mandibular base with the black wax record are chilled and inserted. The patient is instructed to move the jaw forward into protrusion, then backward as far as it will go, until a definite stopping point is both seen and felt by the operator. The operator should be able to detect the most distal point of the jaw movement, for the condyles will usually come to rest with a noticeable impact in the depth of the glenoid fossae. The patient is now instructed to slowly move the jaw, first to one side and then to the other, while the operator observes that, at the end of each movement, the condyles return to the same definite resting place in the fossae. The movement of the black wax on the lower base serves as a guide in studying and comparing the various jaw movements and relations. When the black wax has been observed to come unerringly to rest in the same position against the upper wax occlusion rim, while the jaw is in its retruded rest relation, that position may be regarded as centric jaw relation.

The operator must give instructions in a lucid, simple and quiet manner to avoid confusing the patient. He must be persistent and ready with an occasional word of commendation, which will encourage the patient to quickly and accurately carry out his requests. Since a patient can imitate an example more readily than he can understand a request, the operator should illustrate each movement which he desires the patient to imitate. To avoid difficulty, the patient may be instructed to practice jaw relaxation at home.

It is recommended that the operator

rest on one knee on the chair platform while he obtains records of jaw relations. In this position, he can more readily observe the movements, relations and contact surfaces of the opposing wax rims. In addition, the patient's head is in a more natural and comfortable position when upright.

REGISTERING CENTRIC JAW RELATION BY THE MUSCULAR RELAXATION METHOD

The mandibular denture base is prepared for the registration of centric relation as follows: Two pieces of pink occlusion-rim wax equal in length are cut to fit the bicuspid-molar regions of the base. (Fig. 10.) Each piece is softened in warm water, 120° F., and neatly

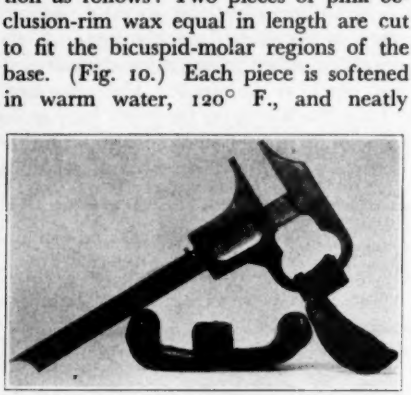


Fig. 8.—Mandibular denture base with intermaxillary black wax record. Left, anterior view. Right, lateral view with Boley gage in measuring position.

adapted and sealed to its respective side of the base, after which it is molded by finger pressure and trimmed to a wedge shape throughout its length. The crests of these pink wax wedges should be about 8 mm. higher than the black wax record in the anterior region. This requirement varies with the intermaxillary space.

Both denture bases are inserted and then examined. The pink wax wedges on the mandibular denture base may be bent toward the buccal or the lingual aspect until the crest of each coincides with the center of the opposing groove in the maxillary wax rim. (Fig. 11.) The patient is instructed to slowly close into the soft wax, which may require resoftening, until the upper surface of the black wax intermaxillary record is within about 4 mm. of touching the maxillary wax rim, whereupon closing is discontinued and both denture bases and rims are removed and chilled. In this manner, the softened wax wedges on the mandibular denture base are flattened against the maxillary wax rim and pressed into the grooves in the wax recording surface. (Fig. 12.) The flattened wedges are now reshaped by the trimming away, with a heated knife blade, of all the flattened portion except the

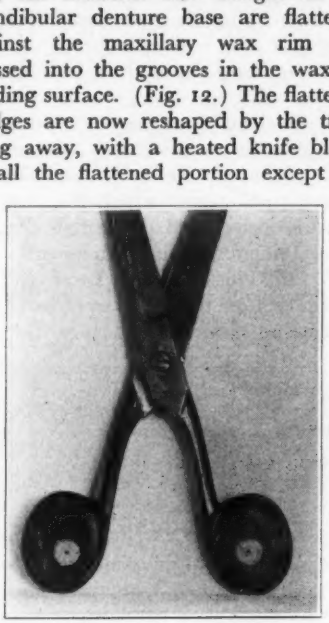


Fig. 9.—Shears used as improvised interpupillary caliper.

crests which fit into the grooves on the maxillary wax recording surface. (Fig. 13.)

The maxillary base, with rim, is chilled, dusted with talcum and reinserted preparatory to recording centric relation. The re-formed wax wedges on the mandibular base are submerged and heated in warm water (130° F.), care being observed not to soften the black wax record in the anterior region, which may be used as a handle in heating the pink wax wedges. When the wedges are softened, the mandibular base is transferred to the mouth and the patient is in-

structed to relax the mandible so that the operator may freely move it. The operator stabilizes the denture base on the lower ridge with the index finger while the thumbs rest under the lower jaw. The mandible is rapidly opened and closed while it is moved gently backward into relaxed centric position. When the jaw is completely relaxed and in the most distal rest position, the operator repeatedly opens and closes the jaws, without biting pressure, into the softened pink wax wedges, until a space of approximately 1 mm. remains between the maxillary wax rim and the black wax intermaxillary record. Balanced centric jaw relation together with the proper intermaxillary denture space is thus recorded. Both denture bases and rims are now carefully removed from the

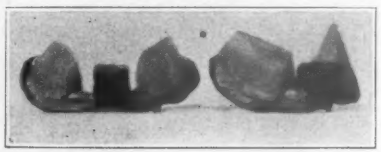


Fig. 10.—Mandibular denture base with black wax intermaxillary record and two pink wax wedges for recording centric relation.

mouth, assembled into the centric relation record (Fig. 14) and chilled in cold water.

GOTHIC ARCH TRACER

I concur with Hanau in the opinion that the gothic arch tracer is a reliable means for visualizing and for confirming centric jaw position. I am further aware of the shortcomings of numerous tracing devices which have been designed for this purpose, and of the materials now in use. The recording of balanced centric relation not only consists in registering a point in space, but it also involves perfect balance between the jaws in centric relation. Although the tracer may locate centric position on a horizontal plane, it records neither the vertical requirement nor balanced relation, without which the centric relation record is incomplete. Frequently, the accuracy of the tracing is marred by subsequent attempts to balance the centric jaw relation, or by the application of pressure, which may cause displacement of the denture bases especially when the denture supporting tissues are yielding. It is believed that centric relation can be simultaneously located and balanced by using the method and materials recommended in this technic, which, however, must be supplemented by acute visual and tactile observations.

CONFIRMING CENTRIC JAW RELATION

The excess pink wax of the wedges

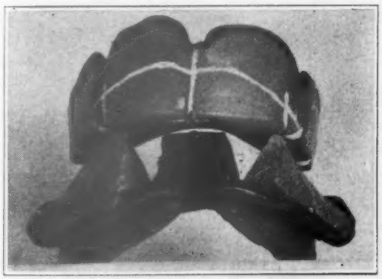


Fig. 11.—Denture bases showing relation of crest of mandibular wax wedges to grooves in maxillary occlusion rim.

which flowed beyond the maxillary rim, thus obscuring the recording surfaces, should be trimmed away with a heated knifeblade. Both denture bases and rims are reinserted, and the patient is instructed to close very slowly, while the upper and lower recording surfaces are examined by the operator, who assists the patient in maintaining centric jaw relation. The recording surfaces are repeatedly and lightly brought together, while the operator makes certain that there is simultaneous and uniform contact throughout the recording surfaces. There must be no tendency for the lower recording surface to slightly protrude at the moment when the rims come together, and the slightest lateral retrusive

or protrusive movement of the lower rim indicates that the jaw relation as recorded is incorrect. It is necessary to retract the lips and turn the patient's head from side to side in order to detect any horizontal (protrusive) movement of the wax record.

MOUNTING THE CENTRIC RELATION RECORD ON THE ARTICULATOR

The mandibular base is prepared for mounting by filling in any undercuts with softened carding wax or plasticene so that later the base may be readily removed from the articular mounting cast. The maxillary denture base is sealed to the upper mounting cast and the mandibular denture base with the wax record is now assembled against the maxillary wax recording surface and securely sealed in the centric relation record. Moistened tissue paper may be adapted to the palate of the maxillary denture base, also to the tongue space of the mandibular denture base to prevent the plaster from covering the lingual borders of the denture base. The articulator is now set preparatory to mounting. Plaster is applied to the mandibular surface of the denture base and to the mounting plate on the lower articulator member, whereupon the upper articulator member is closed, and thus the denture base is brought into the plaster. The condyle elements must be against the stops in centric position while the mandibular base is being mounted. (Fig. 15.)

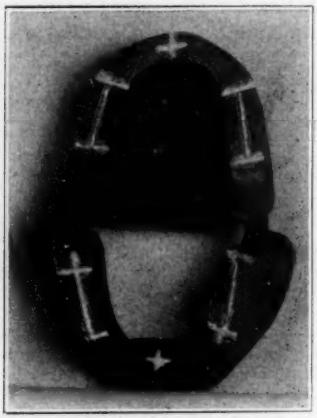


Fig. 12.—Flattened wax wedges, after preliminary centric relation record.

RECHECKING CENTRIC JAW RELATION

After the mandibular denture base has been mounted on the articulator, both denture bases are removed from the articulator and returned to the mouth for confirmation of centric relation. If the operator desires to use a tracing device, it should be attached to the wax rims before they are removed from the articulator. The tracing made in the articulator is then transferred to the mouth and accepted or rejected according to the operator's interpretation of his observations.

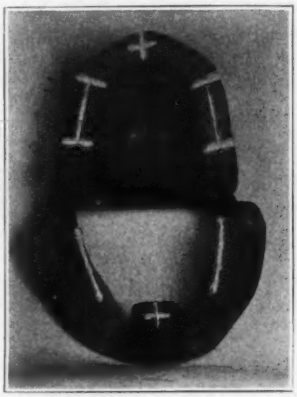


Fig. 13.—Reshaped wax wedges prepared for making final centric relation record.

If, for any reason, the centric relation record is incorrect, balanced centric jaw relation must again be recorded and the base remounted on the articulator. After centric relation has been approved, the pyramid of black wax on the anterior part of the mandibular denture base is removed and replaced with pink base-plate wax so that the labial

contour and incisal height of the mandibular occlusion rim is restored preparatory to setting up the teeth.

MAKING PROTRUSIVE RELATION RECORDS; PRELIMINARY PROTRUSIVE RELATION WAX RECORD

A rod of wax, 5 mm. in diameter, slightly softened in the flame, is sealed to the occlusal surface of the mandibular occlusion rim, care being observed to arrange it near the inner circumference of the rim (Fig. 16), so that it may come in contact with the center of the maxillary occlusion rim when the patient protrudes the mandible. The maxillary occlusion rim is chilled in cold water, dusted with talcum powder and reinserted, in order to test the proper position for the wax rod and also to discover whether there is any interference of the occlusion rims in the mouth before the protrusive relation record is made. The mandibular denture base is inverted and held above a pan of warm water (130° F.) so that the wax rod only is submerged in the water for thorough and uniform heating.

Fig. 14.—Centric relation assemblage.

The mandibular denture base, with rim and softened wax rod, is quickly rotated into the oral cavity, while the free hand assists in distending the lips. The base is stabilized on the lower ridge by the aid of the index fingers. The patient is instructed to slowly move the lower jaw forward. Meanwhile, the operator observes that the lower jaw moves straight forward until it is protruded approximately 6 mm.

At the end of this protrusive movement, the patient is instructed to close very slowly, without biting stress, into but not through the softened wax. The operator watches the displacement of the softened wax rod until the upper and lower rims in the anterior region are approximately within 1 mm. of each other (Fig. 17), whereupon the patient is instructed to stop closing and to hold the jaw in that position for a few moments, after which the mouth is gently opened and the record is removed. The denture bases and rims are now assembled into this protrusive relation wax record and chilled in cold water.

PRELIMINARY ADJUSTMENT OF CONDYLE INDICATORS

The denture bases and wax record are transferred to the articulator, which has been prepared for the protrusive relation record by removing the rubber band from the condyle shaft, and by loosening, cleaning and oiling the indicators so that they rotate freely. The denture bases are separately and securely seated on their respective mountings, the upper articulator member is closed and the maxillary contour model is assembled into the protrusive relation wax record on the mandibular denture base. Pressure is now made on the upper member of the articulator directly above the upper mounting cast so that the rims are securely seated in the protrusive wax record, while the denture bases are accurately seated on their respective mounting casts. The loosened condyle indicators are rotated back and forth until the maxillary wax recording surface fits accurately into the protrusive wax record. When this point has been determined, the thumb locknuts are tightened and thereby each condyle indicator is locked in the adjusted position. (Fig. 18.)

This, the first and preliminary pro-

trusive relation record, is to be used only as a basis for subsequent records.

PROTRUSIVE RELATION GUIDE

In order to have the least amount of variation in subsequent protrusive records, a protrusive relation guide may be established on the labial surface of the maxillary and mandibular occlusion rims when they are in protrusive relation on the articulator. If, in the protrusive relation, the mandibular wax rim extends anteriorly beyond the labial surface of the maxillary wax rim, a small piece of pink wax or a pin may be added to the labial surface of the maxillary wax rim. This piece of wax or pin provides a guide for the median line and likewise an indicator for the proper protrusive distance.

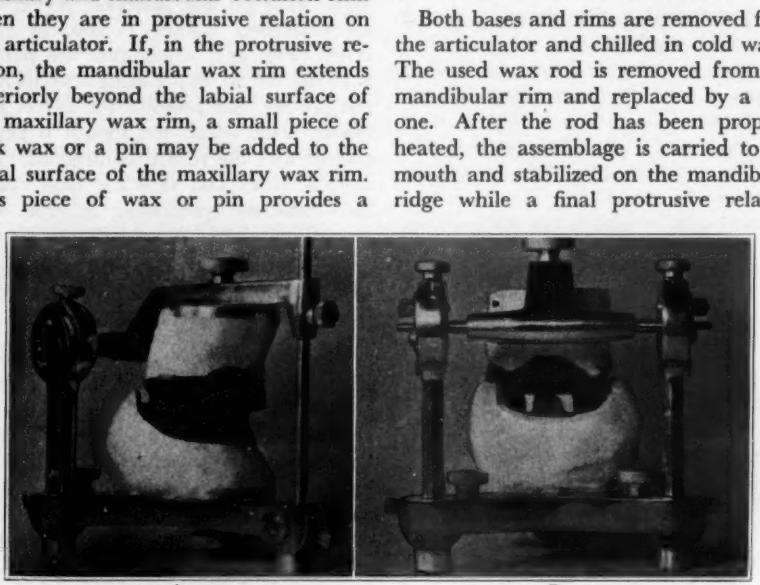
When a pronounced retruded jaw relationship is present, the overjet is usually so great that the mandibular wax rim remains distally to the maxillary, even when the mandible is in protrusive relation. It is necessary, therefore, to add an additional piece of wax to the labial surface of the mandibular wax rim and build it out until it is flush with the labial surface of the maxillary wax rim when the articulator is protruded 6 mm.

This protrusive relation guide provides the operator with a definite point at which he may subsequently record the same protrusive relation in the patient's mouth; for when the guide and the median line markings on the wax rims coincide in the mouth, the proper protrusive relation has been attained.

MAKING FINAL PROTRUSIVE RELATION WAX RECORDS IN THE MOUTH

Both bases and rims are removed from the articulator and chilled in cold water. The used wax rod is removed from the mandibular rim and replaced by a new one. After the rod has been properly heated, the assemblage is carried to the mouth and stabilized on the mandibular ridge while a final protrusive relation record is being made. The patient is instructed to move the mandible slowly forward without bringing the rims together. The operator observes and he assists the patient in keeping the median line markings coincident while the mandible moves forward. When it has moved forward to the proper point, as indicated by the protrusive guide, the patient is instructed to close very slowly without pressure into but not through the softened wax, to hold steadily in that position for a few moments and then to open.

The maxillary and mandibular denture bases are again removed from the



A B

Fig. 15.—Mandibular denture base with centric relation record mounted on articulator. A, lateral view. B, lingual view.

mouth, carefully assembled into the protrusive relation record and then chilled in cold water. They are now reseated on their respective articulator mounting casts and brought together into the protrusive wax record. The condyle indicators are loosened and rotated to the position of least resistance, while the rims are perfectly stabilized in the protrusive wax record and the denture bases are accurately seated on the mounting casts.

Three such protrusive records should be made in the mouth and the condyle indicators of the articulator should be adjusted accordingly. These three records should show little, if any, variation in the condyle indications. Any variation in these records may be traceable to several sources, namely, the wrong mounting on the articulator, loose fitting of the bases, an improper softening of the wax rod, closing "through" with biting stress instead of "into" the wax record, instability of denture bases, due to yielding supporting tissues, interference between the maxillary wax rim and the mandibular denture base on one or both sides or any other circumstance which may tend to disturb the balance between the opposing bases and rims. After the settings of the condyle indications have thus been confirmed by subsequent protrusive records, each condyle indicator is locked in the accepted position and a record of the reading on each indicator dial is transcribed on a chart for future reference.

Fig. 16.—Mandibular denture base with wax rod prepared for protrusive relation record.

TESTING ARTICULATOR PROTRUSIVE RELATION RECORDS IN THE MOUTH

The adjustment of the articulator so far has been made by the use of unstrained protrusive relation records from the patient's mouth. It is now advisable to reverse the procedure by making a protrusive relation wax record in the articulator which may be tested in the patient's mouth. This record is made as follows: The pillars (lateral indicators) of the articulator are set parallel at zero degrees. The mandibular wax rim is again prepared by replacing the old record with a new wax rod. The denture base with softened wax rod is replaced on the articulator. The upper articulator member is moved backward, the desired amount of protrusion thus being induced. The maxillary occlusion rim is now closed against the softened wax rod to make a protrusive record in the articulator. The denture bases with the record are now removed from the articulator, chilled in cold water and transferred to the patient's mouth. Each base is

Fig. 17.—Protrusive relation record in mouth.

seated on its respective ridge and the patient is instructed to move the lower jaw forward until the recording surfaces of the maxillary and mandibular rims come together in the protrusive relation articulator record.

A critical examination of the interrelation of the recording surfaces is made without biting pressure. There should be perfect balance between the wax recording surfaces at the instant they come together.

The patient's tactile sense is of great value in this test, for he is able to feel the contact distribution between the recording surfaces. If the relation is unbalanced, the patient, when questioned,

Fig. 18.—Articulator adjusted by use of protrusive relation wax record.

will explain that in a particular region, the contact is premature; whereas, in another area, the contact is lighter or lacking. When the relation is not balanced, it will be necessary to review carefully the preceding steps of the technic in order to find the cause of, and to correct, the error. If the original mouth protrusive relation records are correctly taken, the protrusive records made in the articulator will be balanced when examined in the mouth.

LATERAL RELATION RECORD

Hanau was of the opinion that the setting of a lateral indication by the use of an anatomic record does not offer any particular advantage in the initial stages of denture construction. He stated that the required over-protrusion on the working side in lateral relation cannot and need not be predetermined, but that it should be established on the finished case in the mouth by records, observations and interpretation of symptoms on the denture supporting tissues.

In order to avoid the technical difficulties and inaccuracies encountered in recording suitable lateral relation records, Hanau recommended the formula $L=\frac{H}{8}+12$ to determine an acceptable lateral indication for the initial articulator adjustment.

The preceding description completes the first of three series of protrusive relation wax records used in making complete prosthetic dentures. After the articulator has been adjusted by the first series, the teeth are arranged, occluded and articulated for trial in the mouth.

TRIAL DENTURES AND THE SECOND SERIES OF PROTRUSIVE RELATION WAX RECORDS

After the trial dentures have been tested in the mouth and approved, the second series of protrusive relation records is made exactly as the first series, except that the wax rod is placed on the occlusal surfaces of the lower teeth. These records usually confirm the preceding ones and the setting of the condyle indicators on the articulator usually remains the same, or nearly so. The dentures are now completed and prepared for insertion.

THE FINISHED DENTURES AND THE THIRD SERIES OF PROTRUSIVE RELATION WAX RECORDS

Owing to the materials and procedures involved in replacing the wax denture with the permanent denture material, slight changes in the position of a tooth or teeth may occur. It is recommended

that the finished mandibular denture be remounted on the articulator with a new centric relation record. A softened wax rod is sealed to the occlusal surface of the mandibular denture, and the record is obtained by the operator with the previously described muscular relaxation method. When the mandibular denture has been remounted, centric occlusion is perfected by the use of articulating paper and spot-grinding. After centric occlusion has been perfected, a third series of protrusive relation wax records is made. These records are tested on the articulator, and if they differ from previous records, the articulator is readjusted. Lateral and protrusive occlusion is now corrected by selective spot-grinding followed by paste-grinding. Finally, the occlusion is modified to provide for subsequent resorption of the supporting tissues by grinding for the "rocking fit," as described by Hanau.

Masticatory pressure, owing to the poor stress-resisting properties of dental waxes, cannot be applied until the dentures are finally completed and worn by the patient. Any attempt to introduce and consider the factor of masticatory pressure, while the dentures are being made, can, at best, be only arbitrary and irrelevant to the completed dentures which in reality do not yet exist. It is only after the dentures have been worn that the operator is able to see how the dentures function and to observe whether masticatory function causes disturbances of the cuspal relations.

By careful visual examination and interpretation of the patient's observations, the operator is now able to make slight modifications of the occlusal relations if and as necessary. The patient's tactile sense, the facet markings on the teeth, the reaction of the denture supporting tissues, the functional efficiency of the dentures and the facility with which the patient acquires denture automatism are reliable guides in dealing with the problem of masticatory pressure.

SUMMARY

The method of using intra-oral relation wax records is recommended for use in complete denture prosthesis because: (1) it requires a minimum of equipment; (2) the procedure is simple and readily learned by the operator; (3) the records are accurate within the measurable limits of jaw and denture displacements; (4) the method recognizes and provides for the resilient nature of denture supporting tissues; (5) the procedures are not objectionable to the patient; in fact, the simplicity of the technic encourages the cooperation of the patient while dentures are being made, and (6) as shown by the records, thousands of patients have enjoyed comfortable, efficient and prolonged service with dentures made by this method.

BIBLIOGRAPHY

1. Christensen, C.: A Rational Articulator. *Quart. Circular,* December 1901, pp. 409-420; Problem of the Bite, *D. Cosmos,* 47:1184-1195, October 1905.

2. Fick, R.: Ueber die Form der Gelenk Flächen, 1890.

3. Walker, W. E.: Facial Line and Angles in Prosthetic Dentistry. *D. Cosmos,* 39:789-800, October 1897.

4. Hanau, R. L.: Resilient and Like Effect. *Bull. Chicago D. Soc.,* 13:16, January 7, 1932.

DISCUSSION

F. S. Meyer, Minneapolis, Minn.: When I was asked to discuss Dr. Wright's paper, I readily consented, not knowing what I was up against. I did not realize that I had drifted so far away from the present method of doing this work that it would be difficult to offer an intelligent discussion.

This excellent paper shows a vast background of experience, work and study. And although I may differ with Dr. Wright in some phases of the work, that fact does not decrease my appreciation of the value of the paper.

In speaking of intra-oral records, Dr. Wright says, "Instead, it records posi-

tional jaw relations which, at the teeth, may be identical with occlusal relations in the mouth, but, at the condyle guidance, would rarely if ever be identical with the condyle path of the patient, owing to the resilient and like effect as explained by Hanau." This statement I heartily endorse.

Four conditions are mentioned as interfering with attempts to get accurate intra-oral records:

1. The resilient reaction of the supporting tissue. There can be no question as to the truth of this; on the other hand, if it were not for the resiliency of this tissue, as well as the resiliency of the muscles, cartilages and ligaments in and surrounding the condylar area, none of the dentures as made in the past could have been worn with any degree of comfort.

2. The saliva is mentioned as a factor in interference. I believe that factor is small, since it is usually evenly distributed. Again, if it were not for the saliva as an aid in maintaining suction, at least no upper denture could be maintained in place as it is today.

3. Dr. Wright mentions the fit of the denture base as the major stumbling block. I agree with him in his statement on this point. Every effort should be made to get the best possible adaptation in all denture bases.

4. Dr. Wright speaks of the pressure on the tissues as well as the strained relations of the muscles as a factor. My views do not coincide with his on this point. When the patient is masticating his food, the muscles of mastication are in strained relation and the tissues underlying the dentures are under compression. Therefore, I believe that, under these conditions, the relation of the upper teeth to the lower should be the most accurate. When the mouth is at rest or the teeth contact opposing teeth with the minimum of pressure, no discomfort could follow if they did not make contact as accurately as possible. However, Dr. Wright is correct when he says that no articulator can be adjusted for pressure and no pressure at the same time. That is obvious. And were I to use an adjustable articulator, it is possible that I should also be forced to follow his example. But since I have discarded all adjustable articulators and have sought to obtain balance and function in an entirely different way, I have found it difficult to discuss this excellently prepared paper without appearing to offer destructive criticism.

I am happy to see that great stress is laid on an accurate facebow transfer. In some parts of the country, the use of this valuable instrument is not even taught in the schools.

Dr. Wright's ingenious method of obtaining balance and centric relation is entirely new to me. I have no doubt as to his ability to obtain an accurate balance where there is no pressure, but as to centric relation, I am not quite so sure. It must be understood, however, that a man who has not made an effort to learn and carry out a particular method is not so well qualified to discuss its merits. I shall have to rely solely on my past experience in similar methods.

Dr. Wright says, "The patient is instructed to close slowly and intermittently upon the softened black wax until he feels that the intermaxillary relation is natural and comfortable." Had he said just slowly, he could not have relied on the relationship established; but he says slowly and intermittently. Intermittently I would take to mean that the patient closes into the wax lightly, opens slightly and closes again several times.

If a patient is told to close in a certain way, his mind is on that particular way of closing and he will invariably close incorrectly. But if he is told to close intermittently, his mind is on the repetition of the closing more than on the particular way or position of the closing. He is likely to fall into his natural habits

of closing and close correctly. The force of habit aids him in closing correctly.

When a patient closes into any soft material, the greatest danger comes in closing in partial protrusion. And this is not easily discovered until it is too late. When the teeth are built to this relation of the jaws, great discomfort follows when they are put to the true test in the mouth.

Most of the technical procedures in obtaining these intra-oral records are so unfamiliar to me that I do not feel competent to discuss them in detail. There are, however, some questions that I should like to ask Dr. Wright concerning his methods of checking and making corrections for discrepancies.

He says, "When the mandibular denture has been remounted, centric occlusion is perfected by the use of articulating paper and spot-grinding." I am of the opinion that spot-grinding should be unnecessary when the denture leaves the articulator. And if it is necessary when the denture is finished, this is either because the alinement was thrown out in the pressing or curing, or the alinement was not correct in the first place.

Several years ago, I found that very often the teeth were thrown out of alinement in the curing, and I was very indignant at the laboratories. Although they always made good, it meant much extra work for me. Since adopting the technic I am now using, I do not have that trouble. In other words, I was to blame for that faulty alinement, and not the laboratory. If the alinement and cusp relation are correct on the articulator and the curing is done in stone, it is indeed rare to find a single tooth thrown out of line in the curing.

What can be done if, when the case is finished, a cusp is too short to contact its opposing surface in centric relation?

If a cusp contacts the opposing surface in centric position before the remaining teeth are in contact, is that cusp trimmed off some or enough to even the contacting surfaces or is the opposing surface cut out some or enough to equalize the pressure? If the opposing sulcus is trimmed out, the case will be improved in centric position, but we may find the cusp interfering in some excursions of the mandible. If we then trim off the cusp, there may be a loss of contact in centric relation. Or if it is the buccal cusp of a lower second molar that is too long for the lateral excursion, the trimming may cause a loss of contact in the act of protrusion. And even if the occlusion could be corrected on the articulator, does that mean that it will necessarily be correct in the mouth?

What I wish to establish is this: if the balance and function as obtained on the articulator will not work equally well in the mouth, there must be something faulty in the technic. We must be able to perfect balance and function on the instrument, where we not only can cut down on interfering cusp or other surface, but also can elevate, depress or otherwise move the teeth about when they are in the wax.

How do you determine the true center of the curve of Spee? That is, having determined the height of the lower central incisor above the ridge, how do you determine the height of the lower second molar above the ridge? Or I might ask the same question about the upper.

Dr. Wright also says, "The operator observes, and he assists the patient in keeping the median line markings coincident while the mandible moves forward." It sometimes happens that a patient does not naturally move the mandible straight forward in the protrusive excursion. For various reasons, he has, over a period of years, and perhaps all his life, formed a habit of moving to either the left or the right. If, under such conditions, he is aided in maintaining the median line, what will happen when the teeth are put to use in the mouth without that aid? Will they be in balance?

THE SOUTH AFRICAN FOSSIL MAN-APES AND THE ORIGIN OF THE HUMAN DENTITION

By WILLIAM K. GREGORY, Ph.D., Sc.D., and MILO HELLMAN, D.D.S., Sc.D.,
New York City

AUSTRALOPITHECUS AFRICANUS was the name given by Raymond A. Dart, of Johannesburg, South Africa, in 1925, to a fossil braincast and incomplete skull of a young anthropoid ape, which was found in a late Cenozoic limestone fissure deposit at Taungs, near Kimberly in the Transvaal. Dart, as it now appears, correctly interpreted the fossil as the representative of a hitherto unknown genus of fossil ape, quite distinct from the chimpanzee and gorilla, in some features resembling the orang and in many respects more manlike than any other known form. Hrdlička (1925), who went to South Africa to examine the specimen and its locality, stated that while it was not *the* missing link, it was doubtless *a* missing link, one of the innumerable extinct forms which in ages past connected the now widely divergent families of apes and man; and that since the fossil represented an infant, while the other known fossils of anthropoid apes from Europe and India were known only from adults, one could not identify it satisfactorily and one must await the discovery of adult specimens of the same race. Wolfgang Abel (1931), after a painstaking analysis of the metrical data, concluded that *Australopithecus* was only another extinct genus of ape and that, in many features of its dentition, it was too specialized to be an ancestor of man. Keith (1929), however, pointed out that in many of its characters the young skull of *Australopithecus* was more manlike than that of any other known ape.

In 1936 and 1937, Robert Broom, eminent South African paleontologist, described the fossil skull and upper teeth of an adult anthropoid ape obtained in a "cave limestone" quarry at Sterkfontein, near Krugersdorp, about 30 miles northwest of Johannesburg. Dr. Broom named this skull *Australopithecus transvaalensis,* but later erected for this species a new genus, *Plesianthropus.* The skull of this form was not quite so large as that of a female gorilla, but the general appearance was more human, chiefly on account of the somewhat less prognathous face and remarkably small canine teeth. In the spring of 1937, Dr. Broom attended the Conference on Early Man held by the Academy of Natural Sciences of Philadelphia, where he exhibited casts of this remarkable fossil and pointed out its mingling of apelike and human characters. At the same conference, we showed that the first permanent molar of Dart's original specimen, which is in place along with the deciduous teeth, presents an arrangement of its cusps and grooves that is intermediate between the five-cusped "*Dryopithecus* pattern" (which we regard as ancestral to the diverse lower molar patterns of apes and men) and the six-cusped type found in some primitive men.

In March 1938, we received a cordial invitation from Dr. Broom, acting also on behalf of Director Swierstra of the Transvaal Museum at Pretoria, to come to South Africa and study the dentition

From the American Museum of Natural History.

Read before the Section on Anthropology (H) of the American Association for the Advancement of Science, Richmond, Va., December 30, 1938.

of the South African man-apes, to which he was steadily adding new discoveries: "You can examine on the spot all the *Australopithecus* finds and you will be at liberty to express any opinions you form, whether they confirm or contradict those of the local workers." Soon afterward, we received an equally cordial invitation from Dr. Dart, professor of anatomy and dean of the Medical School of the University of the Witwatersrand, we decided to undertake this journey and June 3, 1938, accompanied by Mrs. Gregory, we sailed for Cape Town. Needless to say, in South Africa, we were most hospitably received and given every facility for study and for obtaining measurements, casts and photographs of the original specimen. The report of our studies on the dentition of the extinct South African man-apes has recently been sent to the Transvaal Museum for

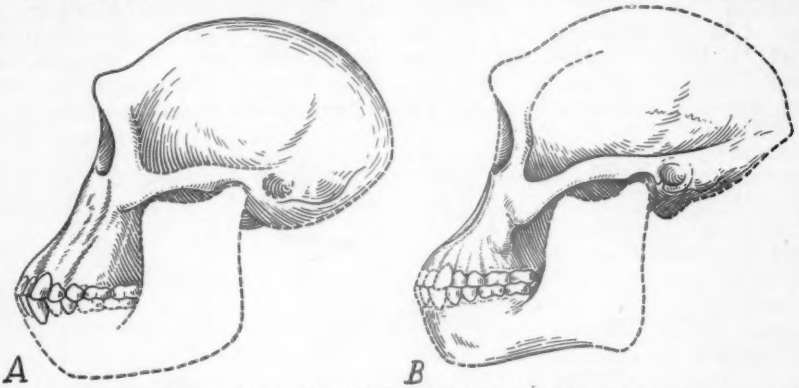


Fig. 1.—Provisional restorations of skulls of (A) *Plesianthropus transvaalensis* and (B) *Paranthropus robustus*. (Mostly after Broom, but with modifications based on authors' study of the material.) (One-third natural size.)

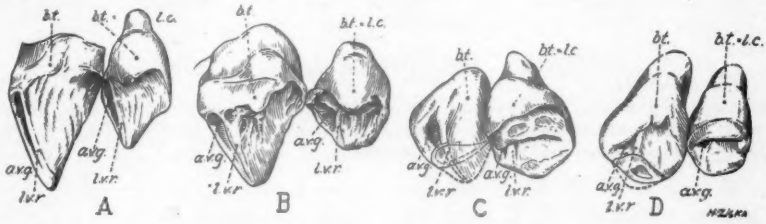


Fig. 2.—Upper canines and first premolars, seen from inner side. A, *Proconsul africanus;* B, *Sivapithecus sivalensis;* C, *Plesianthropus transvaalensis;* D, *Homo sapiens.* (×1½.) a.v.g., anterior vertical groove; l.v.r., lingual vertical ridge; b.t., basal tubercle; l.c., lingual cusp. The anterior vertical groove of the upper canine, very long and deep in Proconsul, becomes progressively short and wide, becoming vestigial in Homo. The lingual vertical ridge, prominent and anterior in Proconsul, retreats and becomes flattened in Homo. Homologous structures in the premolar are less conspicuous. The anterior vertical groove gives rise to the fovea anterior of man and the basal cingulum to the lingual cusp.

Johannesburg, to come there and study his type of *Australopithecus africanus.*

Accordingly, in view of our long interest in problems relating to the origin and evolution of the human dentition, publication in its annals. The present paper is a brief digest and discussion of some of our main findings.

The type skull of *Plesianthropus transvaalensis* Broom must have been nearly

complete before its discovery, but the quarryman's blast blew out the endocranial cast and most of the skull, leaving the imprint of the skull top and part of the cranial roof itself in the rock wall. The braincast of the type skull is estimated by Broom to have been around 440 cc. in volume. It is considerably shorter than the braincast of a large gorilla, but relatively much wider, especially across the frontal region. The temporal lobes, restored by making a cast of the corresponding fossa in the skull, are better developed than in the gorilla braincast. Altogether, the braincast appears to represent a notable advance beyond those of the chimpanzee and gorilla, except in size, it being less short, wide and high than that of the orang. There can be no justifiable doubt that this braincast really belongs with the type skull, for we took particular care to examine the "contacts" between the braincast and the skull, and even in the present condition of the fossil, these contacts are for the most part still intact or plainly evident.

The general appearance of the skull in profile before it was damaged is, we conclude, pretty closely approached by our modified version of Dr. Broom's latest restoration.[1] *Plesianthropus* presents such an astonishing mixture of ape and human characters that, for a long time, we were in doubt whether to call it a very progressive ape or a very primitive man. (Fig. 1.) A third alternative is that it is an ape which has paralleled man in certain features, but this hardly does justice to the numerous features in which it is transitional between the ape and human families. Of these transitional characters, we select for brief notice in the present article the canine teeth, the first upper and lower bicuspids, or premolars, the crown patterns of the molars, the form of the upper dental arch and the results of wear on the grinding teeth.

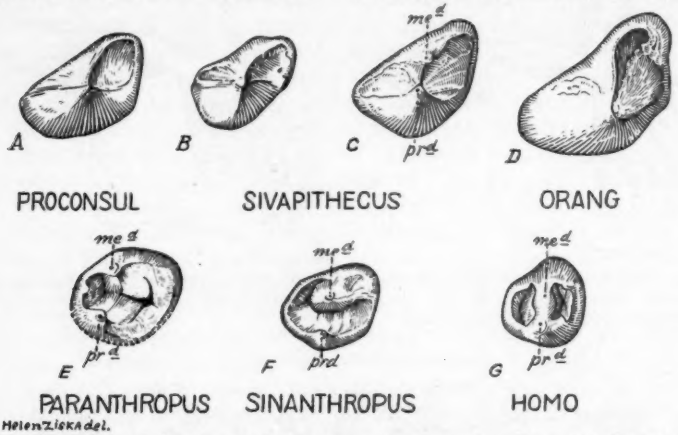


Fig. 3.—Comparison of the lower left first premolar, occlusal surface. (×1½.) A, *Proconsul africanus;* B, *Sivapithecus sivalensis;* C, *Sivapithecus indicus;* D, modern orang; E, *Paranthropus robustus;* F, *Sinanthropus* (after Weidenreich); G, *Homo sapiens.*

In the type skull, the crowns of the upper canine teeth had been destroyed, but the size and position of the roots of both canines prove that these teeth could not have been enlarged and tusk-like as they are in male gorillas and other modern apes. (Fig. 2.) The upper canine, root and crown, is well preserved in another specimen found in the same cave, which also carries the outer incisor and the first molar. The canine in this specimen (Fig. 2, C), which is believed

to represent a female, is actually smaller in its transverse diameter than the first premolar, whereas, even in female apes, it is normally larger than that tooth. Moreover, its crown, although somewhat worn off at the tip, is not dagger-like as it is in typical modern female apes, but altogether more like a human canine.

A well-preserved lower canine found in the same cave is remarkably small in comparison with those of typical modern apes. Its crown has a relatively low tip. This form of canine is sometimes nearly realized in certain female chimpanzees and orangs. It also makes an ideal transitional stage, pointing toward the human lower canine, in which the low crown is becoming more like that of the lateral incisor, with which it is alined. The root, the upper portion of which is preserved, is much more delicate than that of modern anthropoids.

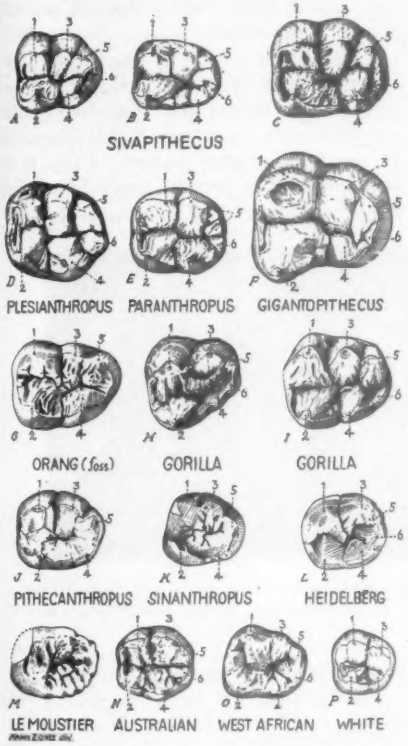


Fig. 4.—*Dryopithecus* pattern of third right lower molar and some of its derivatives. A, *Sivapithecus sivalensis;* B, *S. punjabicus;* C, *S. giganteus;* D, *Plesianthropus transvaalensis;* E, *Paranthropus robustus;* F, *Gigantopithecus blacki* Koenigswald, after von Koenigswald; G, fossil orang, after Weidenreich; H, gorilla ♀; I, gorilla ♂; J, *Pithecanthropus* (from cast and photographs sent by Dr. von Koenigswald); K, *Sinanthropus* (after Weidenreich); L, Heidelberg (after Weidenreich); M, Le Moustier (after Weidenreich); N, Australian aboriginal; O, West African negro; P, white. (×1½.)

The first upper premolar in modern apes has two conspicuous outer roots and the outer surface of the crown is lopsided; also, its outer cusp projects downward much farther than its inner cusp. In the type skull of *Plesianthropus,* this tooth has but one principal outer root, the outer surface of the crown is more nearly symmetrical and the outer cusp projects but little more than the inner cusp, so that the human stage of this tooth is here very nearly realized. However, the buccal root remains distinct from the lingual, as in apes.

The first lower premolar in the most primitive known fossil form (Fig. 3, A) of the great apes *(Proconsul)* from the lower Miocene of East Africa has the fore part of the crown compressed laterally, its oblique outer face shearing against the inner side of the tusklike upper canine. Among the fossil great apes of India, we have several forms (Fig. 3, B, C), in which the compressed first lower premolar crown swings around to an oblique position, and the outer part becomes swollen, the inner contracted. From this stage, it is but a short step to the oval-crowned first premolar of certain modern chimpanzees, in which this tooth has plainly almost reached the typical premolariform stage of man. Unfortunately, the front lower premolar of *Plesianthropus* has not yet been found, but in *Paranthropus,* an allied form from Kromdraai, nearby, this tooth (Fig. 3, E) is known to be in an almost human stage of evolution.

The first and second upper molars of *Plesianthropus* each bear four rounded cusps, not unlike those of old orangs, except that the crowns lack the surface wrinkling seen in the orang. On the other hand, the same general patterns are found in the corresponding teeth of the more primitive fossil men, especially the Peking man *(Sinanthropus pekinensis)*. The difference is chiefly in the much larger size of the second upper molar in the South African man-ape.

In the third upper molar of this form, the rear end of the crown is broken up into a row of beadlike knobs, which suggest a similar appearance in certain members of the Peking and Neanderthal races and even in some modern men.

side with cusp 2; in advanced specimens of modern man, cusp 3 loses its contact with cusp 2 and gains a broad contact with cusp 4. Cusp 5, which is prominent in apes, is often reduced or lost in modern man. By these changes, the Y pattern of *Dryopithecus* becomes transformed into the plus (+) pattern of modern human molars. Cusp 6, which is barely indicated in typical apes, becomes prominent in some men.

In the lower molars of the South African man-apes (Fig. 4, D, E), the *Dryopithecus* pattern is still recognizable, but it is beginning to assume the appearance of the human plus pattern. Cusp 6 is very large, as in certain men. The chief difference from early man is in the rel-

Fig. 5.—Models of upper dental arches of (A) *Sivapithecus sivalensis;* (B) *Plesianthropus transvaalensis;* (C) Heidelberg man (made by J. H. McGregor to fit the known lower dental arch). (One-half natural size.)

The lower molars of apes and primitive men show various modifications of what we have called the *Dryopithecus* pattern (Fig. 4), because this pattern is seen in its primitive form in the fossil ape of that name. On the outer side of each lower molar, there are three main cusps, numbered in our system 1, 3, 5. Number 3 is bounded on its inner slope by two grooves that form a V and the tip of the V is continued to the inner side of the crown, forming a Y. Cusp 2 lies in front of the stem of the Y; cusp 4, behind it. In primitive apes, cusp 3, of the outer row, is in contact on the inner

atively enormous size of m_2 and m_3.

The data for the reconstruction of the upper dental arch, within rather narrow limits of error, which, we believe, will withstand critical analysis, are given in our fuller report. Suffice it to say here that our reconstruction (Fig. 5) shows the upper dental arch of *Plesianthropus transvaalensis* as a structural link between those of the ancient Siwaliks stem-ape, *Sivapithecus sivalensis,* and primitive man, as represented by Professor McGregor's reconstruction of the upper dental arch of the Heidelberg man, which was made to fit the known lower dental arch.

The crowns of the lower grinding teeth of the South African man-apes when well worn present nearly flat surfaces, as in man; whereas those of apes show steep elevations, especially on the inner side. This means that in these structurally intermediate forms, the small size of the canines and the lowering of the cusps of the grinding teeth were making possible the hard-gripping, hard-grinding actions that are indicated in well-worn dentitions

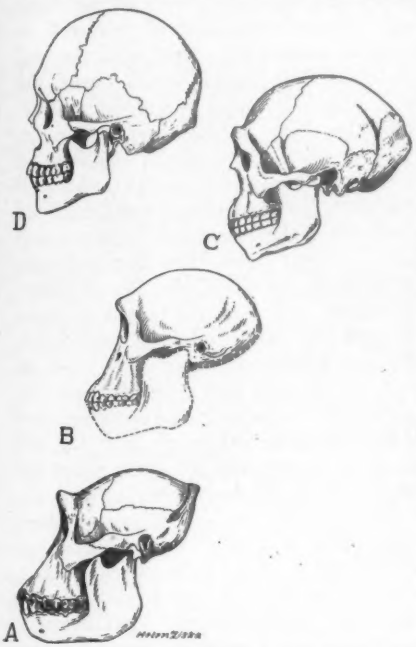


Fig. 6.—Skulls of fossil apes and men. A, gorilla ♂; B, *Plesianthropus;* C, *Sinanthropus;* D, *Homo.* (A, C, D, after Weidenreich.) (About one-sixth natural size.)

of Australians, Eskimos, American Indians and others that chew tough or gritty food.

Modern apes use their sharp canines to pierce and hold tough fruits, bamboo shoots, sugarcane, etc., which are cut into small bits by the more or less sharp-crested molars. Primitive men use their small, almost incisor-like canines to grab and hold parts of the carcasses of animals, and their nearly flat-topped molars to grind flesh, small bones and grain. The South African man-apes were in an intermediate structural stage. As they lived in an open country which was much the same as it is today, they may have chased away the vultures and hyenas and filled themselves with the noisome remnants of the lions' feasts. From the abundance of broken baboon skulls in their caves, Dr. Dart long ago suggested that his *Australopithecus* killed the baboons and broke open their skulls to get at the brains. A gorilla's food habits are widely different from those of primitive man, the gorilla being nearly exclusively a fruit-eater. Nevertheless, the gorilla's digestive tract and all its appendages are almost identical with the corresponding parts in man, except in proportions. The transitional conditions in the dentition of the South African man-apes suggest that there was a gradual shift from frugivorous to omnivorous food habits.

As to the phylogenetic relationships of the Australopithecinae with the existing genera of anthropoid apes, our observations suggest that, in addition to their connections with the chimpanzee-gorilla branch, they may be related, and not very remotely either, to the orangs on the one side and to the human branch on the other. Among the points of agreement with the orang group may be mentioned: the marked concavity of the lower facial profile in *Australopithecus* and *Paranthropus,* the general proportions and patterns of the upper and lower premolars and molars (except for the wrinkling of the crown surfaces in the orang), and the general form, appearance and proportions of the deciduous cheek teeth of *Australopithecus africanus,* which show a curious mingling of human and orang-like characters. The relations of the tympanic plate to the glenoid fossa in *Paranthropus,* cited by Broom as a strongly human character, are nearly approached also in a young orang. The

lower canine of *Plesianthropus* is most closely approached by that of a "fossil orang" shown by Weidenreich (1937, Pl. VII, Fig. 61).

It has always been difficult to understand why man should show so many curious and detailed anatomic agreements with the orangs, in spite of the enormous differences in locomotor habits. The answer may well be that orang and man may have diverged very profoundly and very rapidly from a more chimpanzee-like ancestor and that the Australopithecinae have such a mixture of characters because they were late Pleistocene survivors of the common *Dryopithecus* stock, and were truly related to all their cousins of the modern chimpanzee-gorilla, orang and human branches. This would help to explain also such hitherto puzzling facts as the following:

1. The lower jaw and teeth found with the skull of *Eoanthropus* are so orang-like that they have been classed with the orang group by Freiderichs (1932).

2. The upper molar teeth found near the type skull of *Pithecanthropus erectus* have been identified as orang teeth by Miller[2] and by von Koenigswald.

3. The second upper molar of *Gigantopithecus blacki* Koenigswald shows fundamental resemblances on the one hand to that of *Paranthropus* and on the other to that of the orang.

4. The wrinkling of the molar crowns in the orang is approached in certain molars of *Sinanthropus*.

5. The modern orang has attained a high degree of brachycephalism and hypsicephalism, as have some of the Mongoloid peoples, simply by arrest of the growth of the basis cranii and acceleration of the transverse and vertical growth components of the cranium and face. These parallelisms are far closer than the resemblances between bulldogs and short-faced cats. They are in themselves evidence of remote genetic relationship.

As to the time relationships of the "near men," the field evidence has convinced Dr. Broom and others that they lived in the latter half of the Pleistocene epoch and were therefore the contemporaries, not the direct ancestors, of early man. Nevertheless, the structural evidence indicates that they were at the same time the conservative cousins of man and the progressive cousins of the modern apes.

In conclusion, some anthropologists may regard the South African man-ape group (Fig. 6) merely as a second, later and abortive "attempt of Nature" to evolve a human type long after she had set apart that branch which eventually won fame as evolving into *Homo sapiens*. The facts cited in the foregoing pages, together with the evidence afforded by the morphology of the braincast and skull structure, can hardly leave a well-founded doubt that the Australopithecine group were derived from the *Dryopithecus-Sivapithecus* stock of the late Tertiary of Europe and Asia, the common source of apes and man, and that these South African Pleistocene man-apes were in both a structural and a genetic sense the conservative cousins of the contemporary human branch. Although it is far too much to expect that the close structural approach of *Plesianthropus* toward *Sinanthropus* (Fig. 6) will discourage those who cling hopefully to the myth of Eocene man, all the facts known to date (in contradistinction to unproved assumptions of "irreversibility," "parallelism," etc.) tend in our judgment to confirm the conclusions of Davidson Black,[3] Broom, Weinert and ourselves, who regard man as the result of a morphologic revolution which took place during the late Tertiary period.

BIBLIOGRAPHY

1. *Forum* (South Africa), 1:22, 23, September 5, 1938.

2. Miller, G. S.: In litteris, January 27, March 1, 10, 1917.

3. Asia and the Dispersal of Primates. *Bull. Geol. Soc. China*, 4:133-183, 1925.

57 West Fifty-Seventh Street.

AN ORIGINAL CLASSIFICATION OF ALVEOLAR TYPES IN PERIODONTAL DISEASE AND ITS PROGNOSTIC VALUE: CORROBORATION BY PLASMA PHOSPHATASE DETERMINATIONS

By Samuel Charles Miller,* D.D.S., and Rudolph H. Pelzer,† B.S., D.D.S., A.M., New York City

Of all the diagnostic procedures in dentistry, the interpretation of radiographic findings is the most challenging and still affords a fruitful field for investigation.

In the past, it was considered satisfactory to decide the periodontic fate of a tooth or teeth from the amount of remaining bone. It was conjectured that a tooth with only one-half or one-third of its normal bone support was a poor risk for periodontic treatment, little consideration having been given to the type of bone which remained. Recently, we have come to consider the latter factor to be of far greater importance.

It takes no stretch of the imagination to understand that a telegraph pole anchored in soft sand is not so steady as one set in concrete, the supporting ability of the earth being directly dependent on the type of soil and rock of which it is composed. Yet, in the past, in spite of the radiographic differences in alveolar texture and type, little thought was given to this factor from a prognostic viewpoint.

It was found by one of us (S.C.M.),[2] from progressive study of several thousand radiograms over periods of time varying from one to thirteen years, that the outlook for a specific tooth as seen in a single radiogram can be determined with a fair degree of accuracy, the decision being influenced by what is occurring in the alveolar support at the time the radiogram is taken. Needless to say, it is not intended to establish hard and fast rules which must be applied with mathematical precision, but rather to outline a guide which, with wisdom based on experience, can be of invaluable assistance in predicting the progress of the disease or the outcome of treatment.

*Associate professor of periodontia in charge of the Periodontia Department, New York University College of Dentistry.

†Research associate in the Periodontia Department (Bristol-Myers Fellowship), New York University College of Dentistry.

CLASSIFICATION OF ALVEOLAR TYPES

The rule to be applied can be stated in the following words: Rapidity of bone destruction is in inverse proportion to the uniformity of density of the alveolar support. Thus we find that the following radiographic entities may be realized:

1. Normal alveolar support: The alveolar process is of even density throughout. There is an even distribution of light and dark areas. The crest of the alveolar wall is protected by the lamina dura or peridental lamella which surrounds it and dips down to line the alveolus, leaving a thin dark line or space occupied by the peridental membrane (Fig. 1). At this time, radiographically, there is no suspicion or prediction of disease.

2. Marginal thickening of the peridental membrane line with thinning of

the peridental lamella or lamina dura (Fig. 2): This indicates the beginning of periodontal disease and will enable the dentist to predict by five years the actual clinical appearance of the disease. It is the radiographic equivalent of rarefying pericementitis fibrosa as described histologically by Box.[3]

3. Arrested bone destruction: The bone crest is at a lower level than normal, but the alveolar bone is of even texture throughout, with the same density up to the margin of the bone. The height is dependent on the amount of destruction which has previously occurred. If destruction is arrested for some time, there is a new dense white line over the remaining crest of the alveolar process which continues to form the peridental lamella or lamina dura (Fig. 3).

4. Slow bone destruction: The level of the bone crest may vary and is not an important consideration in determining the rapidity of bone dissolution. When the peridental lamella is absent over the alveolar crest and there is darkening of the alveolar process penetrating only a short distance into the bone septum, it may be considered that a slow destructive process is under way. Beyond the

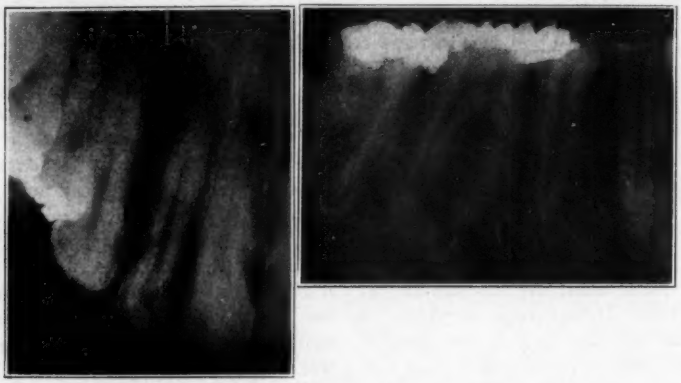


Fig. 1.—Normal alveolar bone in various parts of arch.

Fig. 2.—Marginal thickening of peridental membrane line seen in radiograms. (Areas noted by arrows.)

shallow area of penetration, the remaining alveolar process is of uniform density (Fig. 4).

5. Rapid bone destruction: In this situation, the peridental lamella or lamina dura is already destroyed and there is a gradual darkening of the alveolar bone, increasing toward its present crest, the bone gradually fading into the darkness of the soft tissue covering it. The greater the depth of penetration of this shading into the alveolar process and the more gradual the diffusion from the darkened structure to the lighter structure of normal bone, the more rapid the decalcifying process (Fig. 5).

It should be remembered that variables in radiographic technic will produce a heterogeneity of factors which might confuse the picture presented to the eye. Roentgen-ray exposure, developing technic, angulation of the rays and the position of the film may alter the picture. The alert diagnostician will be able to

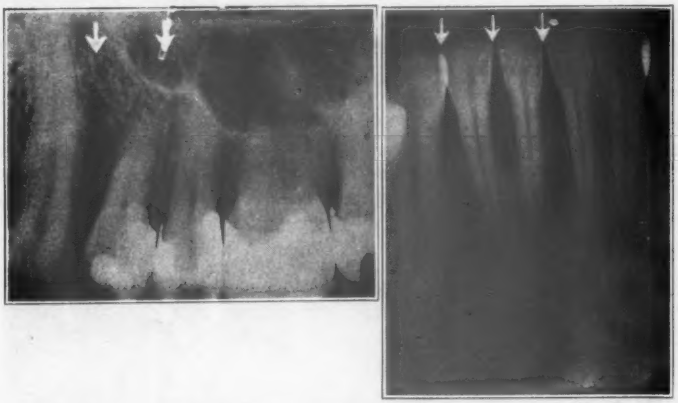


Fig. 3.—Arrested bone destruction seen radiographically. The bone finishes in a definite margin and, in some cases, there is a new lamina dura present. (Areas indicated by arrows.)

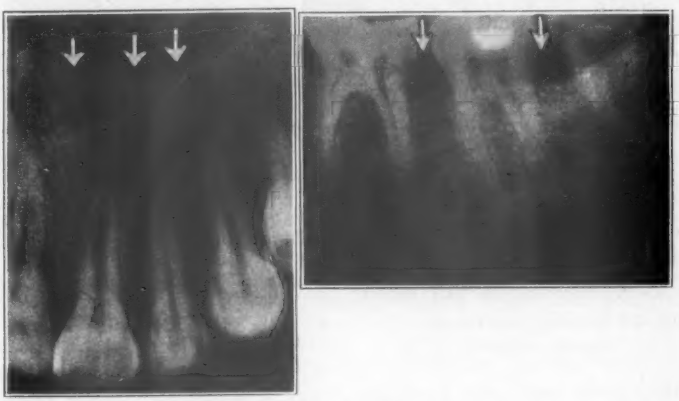


Fig. 4.—Slowly active bone destruction. The bone crest is darkened for a short distance into its depth. (Typical areas indicated by arrows.)

discount these artefacts and modify his prognosis accordingly, or secure other radiographic views in order to obtain as true a picture as possible of the presenting condition.

The etiology is not the important criterion in the above reckoning since the factor may be primarily of a local nature, such as occlusal imbalance; a systemic one, such as a disorder of mineral metabolism, or, as is usually the case, the combination of both types of factors. However, the severity of the disturbing influence and the amount of resistance to its inroads will create the variations in radiographic appearance herein described.

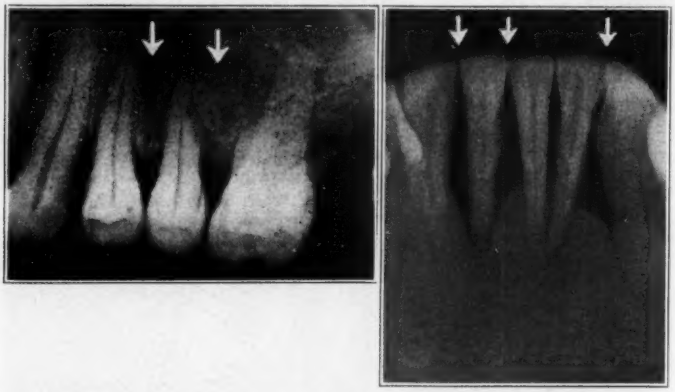


Fig. 5.—Rapidly active bone destruction. The darkening of the alveolar margin penetrates deeply into the body of the alveolar bone. (Areas indicated by arrows.)

LOCAL PLASMA PHOSPHATASE DETERMINATION IN CASES OF ALVEOLAR DISSOLUTION

In various generalized bone conditions such as osteitis deformans, osteomalacia, osteitis fibrosa cystica and rickets, a marked increase in the blood of a specific enzyme, phosphatase, has become well established.[4] The normal function of the enzyme is authoritatively held to be related to the deposition of bone by hydrolyzing such esters as hexose monophosphate or glycerophosphate to cause ". . . a local production in the calcifying zone of an inorganic phosphate ion concentration considerably higher than that found in the blood."[5] Deposition of bone salts occurs when the phosphate ion concentration is increased to exceed the solubility product of the calcium phosphate in the bone complex.

In the calcification process, the phosphatase is produced particularly by the osteoblasts, the proliferating cartilage cells and the cells of the inner layer of the periosteum. In bone disorders, the normal blood phosphatase level is increased owing to such factors as excessive compensatory production by the affected bone[6] or mechanical expulsion of the cellular contents of the disintegrating tissue.[5]

Increased blood phosphatase in adults is found commonly in those bone disorders in which the enzyme production is sufficiently heightened to remain significant despite dilution by the blood stream. It is evident that the bone lesion must be either multiple or extensive to cause such a blood change in spite of the dilution. Since alveolar bone destruction is of a minor nature when the amount of bone involved is considered in relation to the blood stream, it is not

reasonable to assume that measurable variation of the enzyme would occur in the general circulatory blood.

PURPOSE

This study in plasma phosphatase variation in relation to alveolar bone loss was undertaken (1) to trace such changes in phosphatase value as occur both locally in the region of various types of alveolar decalcification and in the capillary blood of the finger and (2) to evaluate the validity of such phosphatase values as an index of rapidity of alveolar bone loss in comparison to radiographic findings.

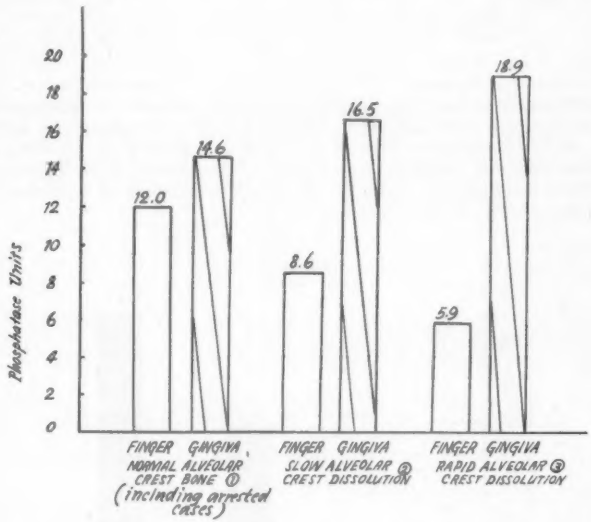


Fig. 6.—Mean finger and gingival plasma phosphatase findings. 1. Medial mean phosphatase units found in finger capillary blood and in gingival blood sample from region of radiographically normal and arrested bone by described method. 2. Medial mean phosphatase units found in finger capillary blood and in gingival blood sample from region of radiographically indicated slowly active alveolar crest dissolution. 3. Medial mean phosphatase units found in finger capillary blood and in gingival blood sample from region of radiographically indicated rapidly active alveolar crest dissolution.

creased quantity of inorganic phosphate. The phosphate value of a given sample taken before and after the action of the enzyme has been permitted to take place on a suitable substrate for a fixed period of time at a constant temperature yields the index of phosphatase activity.

The nature of the marginal gingival circulation is such as to make it almost impossible to withdraw sufficient blood for the usual methods of estimation of phosphatase activity (Bodansky[7] and Kay[8]). It was necessary, therefore, to employ a method utilizing smaller quantities of blood plasma in the determination. The literature was found to give detailed information on the required micromethod as developed by Lundsteen and Vermehren.[9]

METHOD EMPLOYED IN PLASMA PHOSPHATASE DETERMINATION

All methods of phosphatase estimation are based on its action *in vitro* of hydrolyzing phosphoric esters to free an in-

The procedure, as modified for our purpose, follows:

The gingival tissues over the alveolar area selected for investigation are dried carefully, and the interproximal papilla is removed by a sharp scalpel to the height of the alveolar bone, with the least possible trauma. Fifty cubic millimeters of the resultant blood in the area is drawn directly into a small measuring pipet and washed into 1,000 cubic millimeters of a 0.9 per cent sodium chloride solution. The corpuscles are centrifuged out, a clear supernatant liquid sufficient for two analyses and two blank experiments remaining.

Two hundred cubic millimeters of the supernatant liquid is added to 200 cubic millimeters of substrate (made up of 8 cc. of N ammonium hydroxide + 12 cc. of N ammonium chloride + 1 gm. of disodium B glycerophosphate + 2 cc. of M magnesium chloride; to 100 cc. of water). The solution is permitted to

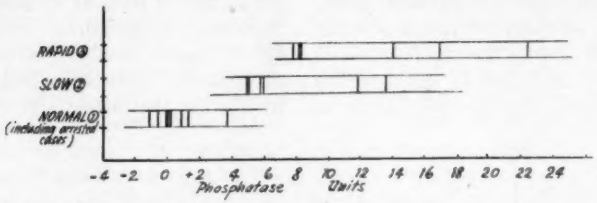


Fig. 7.—Distribution of findings in differences of plasma phosphatase values. 1. Distribution of findings in differences of local plasma phosphatase units in region of radiographically normal and arrested alveolar crest bone and finger capillary blood. 2. Distribution of findings in differences of local plasma phosphatase units in region of radiographically indicated slow type alveolar crest dissolution and finger capillary blood. 3. Distribution of findings in differences of local plasma phosphatase units in region of radiographically indicated rapid type alveolar crest dissolution and finger capillary blood.

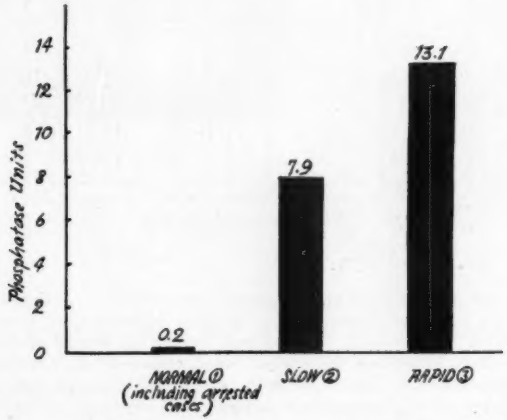


Fig. 8.—Mean calculated differences in plasma phosphatase values. 1. Mean plasma phosphatase unit differences between local plasma phosphatase units in region of radiographically indicated normal and arrested alveolar crest bone and finger capillary blood. 2. Mean plasma phosphatase unit differences between local plasma phosphatase units in region of radiographically indicated slow type alveolar crest dissolution and finger capillary blood. 3. Mean plasma phosphatase unit differences between local plasma phosphatase units in region of radiographically indicated rapid type alveolar crest dissolution and finger capillary blood.

incubate in a constant temperature water bath for 24 hours at 37° C. The reaction is then stopped by adding 300 cubic millimeters of 10 per cent trichloracetic acid. A blank determination is carried out simultaneously, in which 200 cubic millimeters of enzyme solution, 200 cubic millimeters of substrate and 300 cubic millimeters of trichloracetic acid are mixed without the intermediate incubation. The precipitated protein matter is centrifuged out from each, and a phosphorus determination carried out with the clear supernatant liquid. Four hundred cubic millimeters is removed and 100 cubic millimeters of sulfuric acid-molybdate solution (100 cc. of 7.5 per cent ammonium molybdate solution + 45 cc. of 10 N sulphuric acid + 105 cc. of water) and 100 cubic millimeters of amidol solution (15 gm. of sodium sulphate + 15 gm. of amidol in 100 cc. of water, diluted five times with water before use) are added. The intensity of the blue color which develops in fifteen minutes is determined by a Pulfrich "stuphenphotometer" with 10 mm. cells in the micro-attachment, using red filter No. 72.

The difference in the amounts of phosphorus in the analysis and the blank experiment is then the amount of phosphorus which has been liberated by the phosphatase. Since the amount of phosphorus liberated is proportional to the amount of phosphatase, the unit chosen in this method is the amount of phosphatase which, in twenty-four hours at 37° C., will liberate 1 mg. of phosphorus from the given substrate. "If the amount of phosphorus liberated in the 400 cubic millimeters used in the phosphorus estimation is termed *a*, and the fraction of the whole blood constituted by plasma, *pl*, then the total amount of phosphorus liberated per hundred cubic centimeters of plasma after a reaction time of twenty-four hours is given by:

$$a\left(\frac{700}{400}\right)\left(\frac{1050}{200}\right)\left(\frac{100}{50\ pl}\right)1000=\frac{a}{pl}\,18375\,\text{mg. P}''$$

A similar procedure is carried out with a blood sample from a finger prick of the same patient.

TABLE 1.—PHOSPHATASE VALUES IN RADIOGRAPHICALLY NORMAL ALVEOLAR CREST BONE

Specimen No.	Age of Patient	Source of Specimen	Original P Units	P Units After Incubation	Calculated Phosphatase	Difference in Phosphatase Values
62	34	Gingiva	4.5	12.8	8.3	−1.3
63		Finger	4.4	14.1	9.6	
80	35	Gingiva	4.8	11.7	6.8	−0.6
81		Finger	4.3	11.6	7.4	
33	28	Gingiva	8.0	17.7	9.7	0.0
34		Finger	7.4	17.0	9.7	
78	29	Gingiva	3.8	17.1	13.4	+0.1
79		Finger	3.6	16.9	13.3	
31	42	Gingiva	7.1	15.1	8.0	+0.6
32		Finger	7.6	15.0	7.4	
39	38	Gingiva	12.9	32.3	19.4	+1.0
40		Finger	12.7	31.2	18.4	
72	22	Gingiva	3.5	14.0	10.5	+1.4
73		Finger	3.4	12.5	9.1	
35	30	Gingiva	6.5	31.3	24.8	+3.6
36		Finger	6.4	27.6	21.2	

The plasma determination was taken by means of a finger blood sample as described by Van Allen.[10] The difference, therefore, between the plasma phosphatase value of the blood in the region of the alveolar bone and of the capillary blood of the finger would indicate the deviation from the normal due to the progressive destructive process.

EVALUATION OF PLASMA PHOSPHATASE FINDINGS

The limited number of cases thus far investigated permits only cautious interpretation of the findings. The detailed data on normal alveolar bone are presented in Table 1. The findings with the described slowly active type of alveolar bone dissolution are shown in Table 2, and Table 3, in a like manner, indicates the findings with the radiographically indicated rapidly active type of alveolar bone destruction. Indication of positive or negative differences in plasma phosphatase value was in all cases made by arbitrarily designating the findings from

TABLE 2.—PHOSPHATASE VALUES IN RADIOGRAPHICALLY INDICATED SLOW ALVEOLAR CREST DISSOLUTION

Specimen No.	Age of Patient	Source of Specimen	Original P Units	P Units After Incubation	Calculated Phosphatase	Difference in Phosphatase Values
58	30	Gingiva	7.8	21.2	13.4	+ 4.7
59		Finger	7.6	16.3	8.7	
29	60	Gingiva	6.7	21.9	15.2	+ 5.6
30		Finger	7.3	16.9	9.6	
54	28	Gingiva	6.1	18.8	11.5	+ 5.7
55		Finger	7.2	12.0	5.8	
70	36	Gingiva	4.7	23.9	19.2	+ 5.9
71		Finger	4.6	17.9	13.3	
25	52	Gingiva	8.8	25.7	16.9	+11.9
26		Finger	11.6	16.6	5.0	
66	41	Gingiva	5.4	28.2	22.8	+13.6
67		Finger	4.3	13.5	9.2	

TABLE 3.—PHOSPHATASE VALUES IN RADIOGRAPHICALLY INDICATED RAPID ALVEOLAR CREST DISSOLUTION

Specimen No.	Age of Patient	Source of Specimen	Original P Units	P Units After Incubation	Calculated Phosphatase	Difference in Phosphatase Values
74	32	Gingiva	3.5	17.0	13.5	+ 7.9
75		Finger	3.5	9.1	5.6	
82	36	Gingiva	4.7	25.7	21.0	+ 8.3
83		Finger	6.0	18.7	12.7	
64	22	Gingiva	4.0	18.8	14.8	+ 8.4
65		Finger	5.2	11.6	6.4	
60	25	Gingiva	4.0	23.5	19.5	+14.2
61		Finger	3.9	9.2	5.3	
21	51	Gingiva	17.0	34.4	17.4	+17.1
22		Finger	15.2	15.5	0.3	
19	38	Gingiva	14.5	41.6	27.1	+22.4
20		Finger	13.7	18.4	4.7	

the finger blood as the subtrahend and expressing the remainder as the difference.

The average findings of the individual calculated phosphatase values from the finger and the gingival tissue of each of three types of bone are indicated in Figure 6. It will be noted that the average phosphatase value of the gingival blood rises from 14.6 phosphatase units in normal cases to an average of 16.5 in the slow type of alveolar destruction, and reaches an average of 18.9 phosphatase units with the rapid type of alveolar crest dissolution. This change would seem to be directly related to the bone destruction occurring in the region. An unexpected finding is revealed by the plasma phosphatase results of the finger samples with the various alveolar bone types. The average phosphatase value of 12.0 units in the normal cases is successively reduced to 8.6 units in the slowly active alveolar dissolution cases and reaches to but 5.9 phosphatase units in the rapid type. Age variations occurring in the different groups are not sufficient to explain the uniform trend. The validity of this phase needs further corroboration.

Figure 7 indicates the distribution of the differences in the findings of finger and gingival phosphatase units. The range for the normal alveolar bone between — 1.3 and + 3.6 phosphatase units is seen to be relatively limited. Alveolar crest dissolution of the radiographically identified slow type covers a larger range of + 4.7 to + 13.6 phosphatase units. A definite overlapping in values is noted in the wide distribution of the phosphatase differences in the rapidly active type of alveolar crest disintegration. Variations in the findings between + 7.9 and + 22.4 units indicate some values to be similar to the slow type, but other determinations of the rapid type of destruction give greatly increased differences in phosphatase value.

If the total unit phosphatase differences of each of the three divisions of bone types are averaged, marked differences become discernible. Figure 8 illustrates the average differences in phosphatase value of normal alveolar bone, and the radiographically indicated slow and rapid types of alveolar crest dissolution. An unmistakable trend is indicated from the normal low of 0.2 phosphatase units to 7.9 units with the radiographically indicated slowly active type of alveolar crest dissolution, to the final high value of 13.1 phosphatase units in the radiographically indicated rapid type of involvement.

SUMMARY

1. It is possible to distinguish radiographically the activity of alveolar dissolution and to determine its rapidity.

2. A classification of alveolar types in periodontal disease is suggested which predicts the onset of the destruction and reveals the prognosis of the involved teeth.

3. The radiographic findings are corroborated by laboratory investigation which indicates lowest mean difference in local phosphatase levels in arrested and normal cases, higher phosphatase levels locally in slowly active alveolar crest disintegration and highest local phosphatase levels associated with rapid bone dissolution.

BIBLIOGRAPHY

1. Miller, S. C., et al.: Oral Diagnosis and Treatment Planning. Philadelphia: P. Blakiston's Son & Co., Inc., 1936.

2. Miller, S. C., et al.: Textbook of Periodontia. Philadelphia: P. Blakiston's Son & Co., Inc., 1938.

3. Box, H. K.: Treatment of Periodontal Pocket. Toronto: University of Toronto Press, 1928.

4. Morris, N., and Peden, O. D.: *Quart. J. Med.*, 6:211-230, April 1937.

5. Kay, H. D.: Phosphatase in Growth and Disease of Bone. *Physiol. Rev.*, 12:384, July 1932.

6. Duvoir, M.; Layani, F., and Pautrat, J.: *Bull. et mém. Soc. méd. d. hôp. de Paris*, 51:1602, December 2, 1935.

7. Bodansky, A.: *J. Biol. Chem.*, 120:167-175, August 1937.

8. Kay, H. D.: *Brit. J. Exper. Path.*, 10: 253, August 1929; *J. Biol. Chem.*, 89:249, November 1930.

9. Lundsteen, E., and Vermehren, E.: Micromethods for Estimation of Phosphates in Blood Plasma and Inorganic Phosphorus in Blood. *Compt. rend. trav. lab. Carlsberg, Ser. chem.*, 21:147-166, No. 10, 1936.

10. Van Allen, C. M.: Hematocrit Method. *J. Lab. & Clin. Med.*, 10:1027, September 1925.

11. Greenfield, A. L.: X-Ray Technique and Interpretation of Dental Roentgenograms. Brooklyn: Dental Items of Interest Publishing Co., 1936.

12. Stillman, P. R., and McCall, J. O.: Clinical Periodontia. Ed. 2. New York: Macmillan Co., 1937.

13. Best, C. H., and Taylor, N. B.: Physiological Basis of Medical Practice. New York: William Wood and Co., 1937.

ECTOPIC ERUPTION OF PERMANENT TEETH *

By Charles A. Sweet, D.D.S., Oakland, Calif.

FOR a number of years, I have observed the early or premature loss of deciduous teeth in my practice of children's dentistry. Most authorities attribute these early losses to the ravages of caries, extraction or trauma. In November 1935, Samuel J. Lewis[1] presented his observations on the ectopic eruption of permanent teeth at the annual meeting of the American Dental Association. These observations created a desire in many to make additional or further studies of this unobserved cause of malocclusion.

Have cases of ectopic eruption of permanent teeth been unobserved or is it an entirely new development in the child's mouth? Surely, orthodontists and children's dentists would have observed and recorded the findings previous to Dr. Lewis if it were not a new development in the life of the human being. My own observations and conclusions are that ectopic eruption did not occur or was very rare until ten or fifteen years ago. It is, I believe, an entirely new development. If my conclusions are correct, the causative factors are of an evolutionary nature. Is this not a step in the eventual loss of permanent teeth in addition to the third molars, bicuspids and lateral incisors that are now sometimes found absent?

Willett suggests that when the upper first permanent molar erupts and there is early loss of the second deciduous molar, the condition may be due to a lack of resistance of the alveolar process with a toughness to the overlying gum tissue, which causes the permanent molar to drift in the line of least resistance until it breaks down the thin wall of process between it and the roots of the second deciduous molar. While this suggestion will fit the case of the upper first permanent molar, it does not seem to explain the early loss of upper and lower deciduous cuspids, lower second deciduous molars or deciduous lateral incisors.

As long as science continues to learn more about the art of living by concentrates or substitutes in pellet, capsule or pill form, the human being will more and more discontinue using the masticatory

* Read before the Section on Children's Dentistry and Oral Hygiene at the Eightieth Annual Session of the American Dental Association, St. Louis, Mo., October 25, 1938.

1. Lewis, S. J.: Ectopic Eruption of Permanent Teeth. J.A.D.A., 22:1019, November 1935.

apparatus. This will bring about a diminution of the jaws, with the end-result of more permanent teeth missing. Coupled with this is the fact that today medical science has made it possible for eight out of every ten children to grow to adult life instead of only five out of every ten. It is no longer a "survival of the fittest" but the survival of the medically fit. This 60 per cent increase in those that live to adult age is attended by many glandular and physical imbalances, which are sure to affect the teeth, alveolar process and mouth as a whole.

Twenty years ago, about 33⅓ per cent of all malocclusion observed in our practices was inferior protrusion, but today 90 per cent or more of cases show a closed bite with other complications. Today inferior protrusion is so uncommon that the young men in the practice of dentistry look upon it as an oddity. We all must be concerned about this lack of development of the mandible and maxillae. Much can be said about the work of Rogers, of Boston, and Fisk, of Toronto, in favor of their development exercises, which can do no harm and may do untold good.

Should we go on observing, hoping that nature will correct these symptoms that may or may not develop into serious malocclusion? It is my belief that some sort of treatment should be instituted as soon as conditions are observed that are a departure from the normal. Orthodontists, generally speaking, are too much inclined to watchful waiting or, worse yet, take a very simple case and make it into one with extreme complications. It is

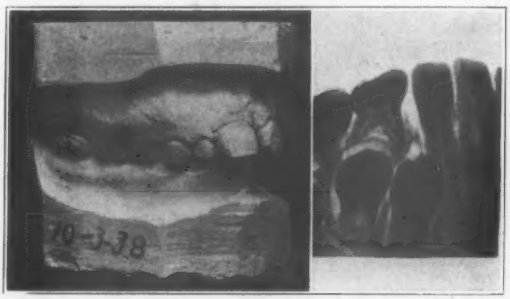


Fig. 1.—Early loss of deciduous cuspid with protrusion of upper anterior incisors.

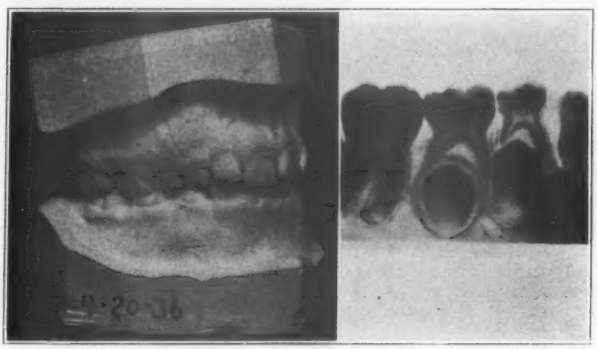


Fig. 2.—Early loss of deciduous cuspid with collapse of upper anterior incisors.

easy to intercept malocclusion if one knows when and how to use mechanical interference. Ectopic eruption of permanent teeth is a fine example of a condition calling for early interception.

DIAGNOSIS

Ectopic (meaning abnormality of position) eruption of permanent teeth may occur in either jaw and in varied positions. It has been my observation that the frequency of the various positions is in the following order:

Class 1. Eruption of a lower lateral incisor causing premature loss of a lower deciduous cuspid. This usually occurs unilaterally, but in a few instances is bilateral.

With the loss of the lower deciduous cuspid, the upper central incisors sometimes protrude (Fig. 1) or there is a collapse of the upper central incisors. (Fig. 2.) Early interception of these cases of ectopic eruption would have obviated orthodontic interference in the upper arch.

Class 2. Eruption of the upper first permanent molar causing early loss of the upper second deciduous molar. This is usually bilateral. (Fig. 3, A and B.)

Class 3. Eruption of the upper lateral incisors causing early loss of the upper deciduous cuspid. This is usually unilateral. (Fig. 4.)

Class 4. Eruption of the lower first permanent molar causing early loss of the second deciduous molar. (Fig. 5.)

Early diagnosis of ectopic eruption is essential to the elimination of further complications that may necessitate prolonged treatment. Roentgenograms of all suspected cases of ectopic eruption taken every six months to one year will be of great help in determining the time when treatment should be instituted.

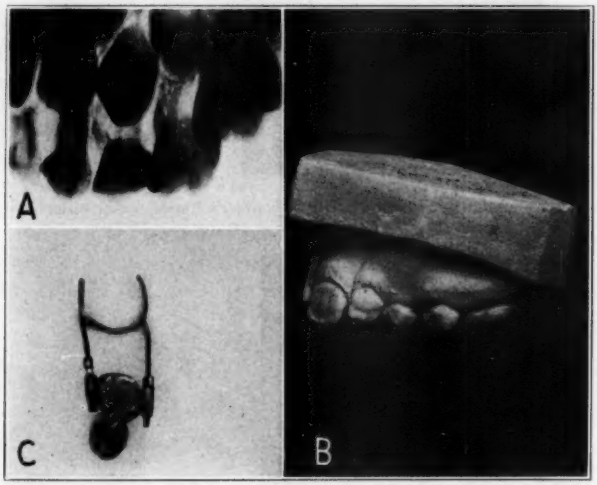


Fig. 3.—A, eruption of first permanent molar under distal portion of second deciduous molar. B, same case four years later. C, type of jackscrew appliance that can be used to correct this type of eruption.

TREATMENT

Class 1, Subdivision A. Loss of one or both lower deciduous cuspids can be successfully treated by the use of the lingual arch and finger springs banding the second deciduous molars. The actual

time consumed in the treatment of these cases to completion will average from seven to ten hours.

A lingual lock has been designed to replace the half-round tube and pin, the Ellis Lock or any locking device designed to lock a lingual arch to molar bands that greatly simplifies construction and minimizes adjustment and breakage.

The posterior, or Sweet lingual, tube is placed in a vertical position on the disto-lingual angle of the molar band, the top being about 1 mm. below the occlusal edge of the band. The anterior, or McCoy open, tube is placed in a vertical position on the lingual surface of the mesio-lingual cusp of the molar band about 1.5 mm. below the occlusal edge

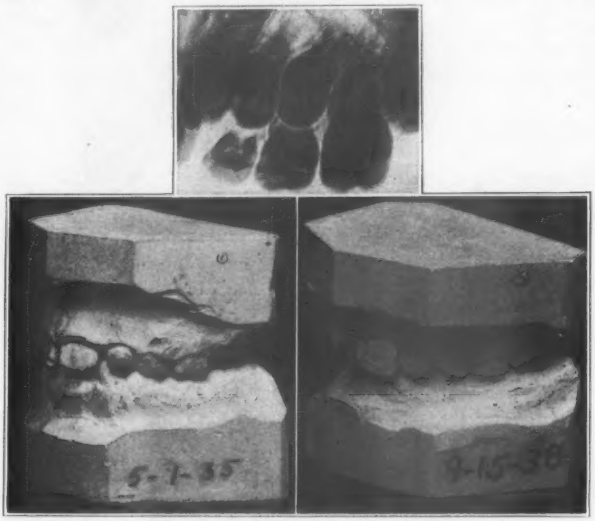


Fig. 4.—Eruption of upper permanent lateral incisor, causing early loss of upper deciduous cuspid.

Fig. 5.—Ectopic eruption of lower first permanent molar.

It consists of a posterior tube called the Thos. R. Sweet lingual tube, and an anterior tube, the McCoy open tube. Both tubes are made of chrome alloy and can be spot welded to chrome alloy band material.

of the molar band. Both tubes are made to carry a 0.030 arch-wire, but are large enough to carry a 0.032 wire. (Fig. 6, A.)

This lock can also be made of noble metals in the following manner and used on noble metal or German silver bands.

For the posterior, or Sweet lingual, tube, a piece of tubing 2.5 mm. long is cut to fit the arch-wire to be used. This tube is soldered in a vertical position just behind the distolingual angle of the band about 1 mm. below the occlusal edge.

The anterior open tube may be made from Wilkinson's open tube material by bending the metal around a round-nosed pliers with beaks approximately the size of the arch-wire to be used. This tube is soldered to the band opposite the mesiolingual cusp, parallel with, and about 1.5 mm. below, the occlusal edge of band.

An arch is then formed of chrome al-

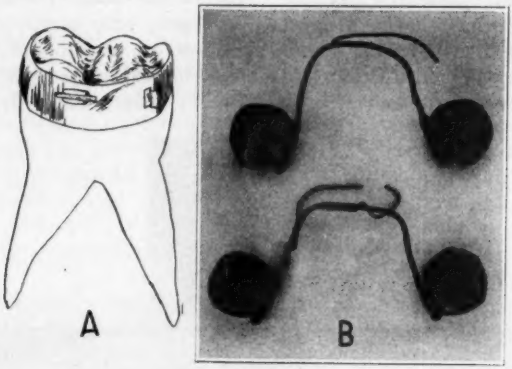


Fig. 6.—Lingual arch, showing Sweet lingual lock.

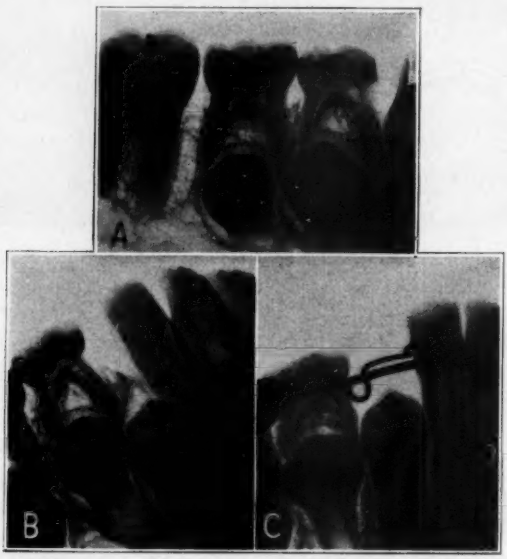


Fig. 7.—A, distal tilting of permanent bicuspid. B, first bicuspid ahead of cuspid in eruption level. C, completion of treatment with normal relation of erupting teeth.

loy or precious metal by bending with pliers to engage the posterior tubes and open tubes, and adapted by heat. Finger springs are soldered to the arch at the desired point to exert mild pressure. (Fig. 6, B.)

Class 1, Subdivision B. If the upper central incisors have collapsed, it will be necessary first to move these teeth anteriorly, to make room for the anterior movement of the lower teeth. This will necessitate the construction of an upper appliance, preferably the labial arch. If early diagnosis of these cases is made, this added work will be eliminated, and time will be saved for the dentist and expense for the parent.

Class 2. It has been my observation that this type of ectopic eruption can be detected in its early stages because, usually, the lower first permanent molars have erupted and there is no evidence that the upper first permanent molars are present. Roentgenographic examination will verify any suspicion, and in case the distobuccal root of the second deciduous molar has been absorbed, extraction of this tooth is indicated. Immediately after this extraction, a Willett type of space maintainer and molar guide should be placed in the mouth to assure a satisfactory result. If the permanent molar has erupted, an appliance should be constructed to effect a distal movement. A jackscrew type of appliance is simple of construction and is rapidly effective.

Class 3. As this type of ectopic eruption has been quite infrequent in my practice, no set type of treatment has been instituted. In some instances, expansion of the mandibular arch has caused a similar expansion of the maxillary arch. In other cases, it has been necessary merely to expand the maxillary arch in the cuspid and first deciduous molar region to obtain sufficient room for normal eruption of the permanent cuspid.

Class 4. Eruption of the lower first permanent molar rarely causes the loss of the lower second deciduous molar as the pronounced curvature of the distal surface of the deciduous molar acts as a guide plane to normal eruption. These infrequent cases can be simply treated with a jackscrew appliance.

CONCLUSIONS

1. Physical and glandular imbalance coupled with the dietary practices of modern civilization in the eating of soft foods results in a lack of development of the jaws which causes ectopic eruption of permanent teeth.

2. Immediate simplified mechanical interference should be instituted in all cases of ectopic eruption to obviate prolonged and expensive treatment at a later period. (Fig. 7.)

3. As normal growth cycles either fail to occur or are latent in the cuspid region, more deciduous cuspids are lost early than any other deciduous teeth. Stimulation of these growth cycles either by exercises or mechanical interference at an early stage will correct many aggravated or prolonged cases of malocclusion.

4. Children's dentists must be more observant of ectopic eruption of permanent teeth as the cases are increasing in number and should have early treatment, which will help to obviate prolonged orthodontic treatment and undue expense.

2940 Summit Street.

VINETHENE ANALGESIA: A TECHNIC FOR DENTAL EXTRACTIONS IN AMBULATORY CLINICS

By SYDNEY S. LYONS, D.D.S., M.D., and HERBERT P. FRANK, D.D.S., New York City

FEAR of pain attending dental extractions still ranks foremost among the real or fancied fears of people in all walks of life. That this fear is well founded is suggested by the innumerable recommendations for drugs and procedures to eliminate pain during extraction without adding to the dangers attending manipulation.

Nerve blocking has been extensively employed without entirely overcoming the difficulties.[1, 2] Despite the refinements in technic and the introduction of new solutions, the method has not gained in favor during the last decade. Reports of syncopal attacks, tachycardia, palpitation and excitement are to be found despite enterprising commercial claims that these drugs will eliminate the toxic reactions which may follow injection of the anesthetic or the accompanying vasoconstricting agent.

A simplified method for nerve blocking and a drug free from toxic manifestations are eagerly awaited. Anesthesia so produced will not have universal acceptance nor be entirely satisfactory until these requirements are met.

Inhalation anesthesia has likewise been subjected to innumerable innovations and improvements during recent years. Improvements in appliances and methods and the introduction of new agents have not afforded a specific technic that has gained exclusive acceptance. There is little argument to refute the assertion that perfection of equipment, comprehensive laboratory and clinical evaluation of drugs and improved facilities for teaching inhalation anesthesia have added to the safety, efficiency and convenience of inhalation anesthesia.[3, 4, 5] It follows, however, as with regional anesthesia, that the dental profession still awaits the introduction of a simple economical appliance which employs a safe, convenient and satisfactory agent for relieving pain accompanying dental extractions.

For the relief of pain and to improve operative technics by inhalation anesthesia, the dental surgeon has at his command three useful anesthetic gases: nitrous oxide, ethylene and cyclopropane, and three volatile drugs: ethyl chloride, ether and vinethene. For ambulatory dental patients, the gaseous agents enjoy wider use and their efficiency is not disputed. However, administration of anesthetic gases and oxygen requires an apparatus that is cumbersome, costly and somewhat complicated. Skill is a primary requisite in administering gases, and their use is not without danger, particularly if one considers the none too rare asphyxia accompanying the use of nitrous oxide and ethylene.[6, 7]

Cyclopropane has not gained wide acceptance because no method for its use is advanced that is more economical or safer than older procedures. Among the volatile agents, ethyl chloride has enjoyed considerable popularity; but again one hesitates to pretend that the possibly increased cardiac irritability and reported

From the Departments of Anesthesia and Oral Surgery, Bellevue Hospital.

sudden deaths from ventricular fibrillation can be ignored.[8] Ether, because of its irritant qualities, which usually delay induction of narcosis, has never lent itself to convenient use for uncomplicated dental extractions.

Vinethene, since its introduction to clinical anesthesia in 1931,[9] has received considerable attention in reports dealing with dental anesthesia.[10, 11, 12] A review of the literature on the subject revealed conflicting and often divergent claims. However, from such a review, one would surely gain the impression that the authors generally agree upon certain pertinent properties and actions of the drug. Investigators who had obviously considered their experience sufficient to express an opinion, record conclusive observations and venture recommendations usually concluded that (1) vinethene is a potent anesthetic agent, no argument being advanced to disprove the statement that a patient may be anesthetized through the different stages of narcosis to respiratory arrest without oxygen want; (2) induction of anesthesia with vinethene is rapid and not unpleasant and recovery likewise complete in a short time; (3) postanesthetic complications and untoward sequelae are infrequent and not extremely serious; (4) the apparatus necessary to administer vinethene need not be complicated or expensive, and (5) extractions were best completed during surgical anesthesia. The official report on this drug issued by the American Medical Association Council on Pharmacy and Chemistry corroborated these findings to a large extent.[13]

With these observations and with careful consideration of the physiologic and pharmacologic studies completed on this drug, it was believed that vinethene merited additional clinical trial and further investigation of its application to anesthesia for uncomplicated extractions. Consequently, it was employed for anesthesia in a small series (100) of unselected cases. Results were encouraging. During this experience, it was observed that prolonged analgesia could be accomplished conveniently with vinethene.

Since analgesia or freedom from pain and a simple procedure that did not hinder the surgeon's manipulation was the ultimate goal, the method was studied intensively. In consideration of the cooperation required for successful maintenance of analgesia, particularly during oral surgery, this study was undertaken in the dental clinic of the Psychiatric Division of Bellevue Hospital. Patients coming to this clinic would seem to be good subjects for an evaluation of a procedure requiring cooperation, since cases of dementia precox, manic depressive psychosis, psychopathic personalities, adult and child behavior disorders and the psychoneuroses are treated.

This report of the results of the study is prepared with the full knowledge that much confusion already exists from the publications extant. It is not presumed that herewith is the final solution to the question of the place vinethene may have in dental anesthesia. Neither is the claim made for a new or revolutionary method for using vinethene. It is merely the description of a technic together with the results from its use. It is written because the procedure has definitely fitted the needs in this clinic.

It may be of interest to review certain of the properties of vinethene that are pertinent when its use for analgesia is contemplated.

Vinethene is vinyl ether, a clear, almost colorless liquid with a characteristic somewhat irritating, but not particularly unpleasant, odor. It decomposes on exposure to air and light. Various aldehydes and peroxides are formed. It is extremely volatile and boils at 82° F. The fact that the drug is inflammable and explosive prohibits its use in the presence of an open flame or a cautery or other electrical heating and surgical units. It is completely decomposed on contact with but a trace of acid. The liquid is mar-

keted in doubly sealed dark colored glass bottles of 10, 25 and 50 cc. capacities. There is an expiration date on the label and the drug is not recommended for use beyond this time. For use by the open drop method, a metal cap is provided, by means of which the rate of flow can be accurately regulated.

sary. The assistant then selects and arranges the necessary forceps, elevators and other instruments to be used. After the surgeon has finished the examination, the anesthetist explains to the patient how analgesia will be carried out, encouraging him and soliciting his confidence and cooperation. Many patients will co-

STATISTICAL ANALYSIS OF ONE HUNDRED CASES OF VINETHENE ANALGESIA

Number of patients			100
Male	66	White	76
Female	34	Colored	24
Extractions			212
Permanent teeth			103
Deciduous teeth			109
Age of patients (average)			13.26 years
Induction period (average)			32.64 seconds
Operating time (average)			1 minute 46 seconds
Recovery period (average)			25.58 seconds
Operating time for single extractions (average)			1 minute 16 seconds
Operating time for multiple extractions (average)			2 minutes 10 seconds
Operating time for deciduous teeth extractions (average)			22 seconds
Most rapid induction			15 seconds
Operating time for permanent teeth (average)			1 minute 40 seconds
Most rapid recovery			7 seconds
Longest induction			66 seconds
Longest recovery			75 seconds
(In a 29-year negress who because of her mental status was intentionally anesthetized to first plane anesthesia)			
Number of patients anesthetized to first plane anesthesia			16
(Of these, twelve were deliberate and purposeful because of the preoperative mental status.)			
Excessive mucus			5
(In no case was this sufficient to interfere with contemplated surgical procedure.)			
Nausea and emesis			3
(In each case, patient had been anesthetized to first plane surgical anesthesia.)			
Loss of bladder control			2
(Both cases in children under 10 years.)			
Quantity of vinethene used			11.5 cc. per case, or 5.3 cc. per minute of analgesia.

TECHNIC

The technic that is employed to administer vinethene for analgesia during the extraction of teeth is as follows: The patient is seated in the dental chair and an examination made to determine the extent of surgical measures necessary. The assistant then selects and arranges the necessary forceps, elevators and other instruments to be used. After the surgeon has finished the examination, the anesthetist explains to the patient how analgesia will be carried out, encouraging him and soliciting his confidence and cooperation. Many patients will cooperate better if convinced that they are helping the anesthetist. Since this study was attempted on difficult and trying patients who presented more than the usual obstacles encountered in regular clinic practice, cooperation was not invariably the rule.

Restraining straps are employed only for the older patients and those mentally disturbed, who, from the nature of their disease, are uncooperative, resistive and tense, and in whom difficulties were anticipated. Restraint is never used in the age groups under 10 years.

The dental chair is then adjusted so that the patient assumes the optimum position for the surgeon's convenience. To prevent cauterization of the skin,[14] that part of the face likely to be exposed to vinethene is lightly covered with mineral oil. This simple precaution is important. A regulation 4 inch hospital gauze square, 40/44 mesh, six layers in thickness, is then cupped over the nose and mouth to form an evaporating surface, upon which the vinethene is dropped. The initial rate is about 60-70 drops per minute from the special dropper supplied with the commercial container.

After about twenty seconds, the patient is asked if he feels any dizziness. A negative reply necessitates a few additional seconds (five to ten) for analgesia to be complete. The patient is constantly warned that he must report any feeling of dizziness.

When dizziness is reported, the patient is requested to open his mouth, and, in practically every instance, he will voluntarily comply with the request. The lower portion of the evaporating surface is then rolled up under the nostrils to uncover the mouth, and a suitable mouth-prop is introduced. Breathing through the mouth is in great measure impeded by walling off the posterior portion of the oral cavity with a piece of gauze, upon which vinethene is dropped while being inserted. It is important that the maneuver be accomplished without unnecessary roughness. This oropharyngeal partition serves to prevent loss of analgesia from the inspiration of an excessive amount of air, and to obviate aspiration or swallowing of blood and mucus. Administration of the vinethene is then confined solely to the gauze covering the nose. The rate at which it is added is slowed to between 20 and 30 drops per minute. Analgesia may be maintained satisfactorily by this amount of drug.

Imprudent administration of vinethene will often result in deepening narcosis to the excitement stage. Should this occur, there is recourse to two procedures: 1. The anesthetic agent may be withdrawn until the patient passes from the excitement stage to that of analgesia. 2. The administration of the agent may be continued until surgical anesthesia is established. Both procedures have been practiced and the results are equally good. The choice will in a great measure depend on the experience and dexterity of the anesthetist. For the majority of cases, it is the practice here to allow the patient to return to the stage of analgesia by discontinuing vinethene. More cautious and closely regulated administration of the drug has then permitted easy maintenance of analgesia.

After extraction is completed, the gauze evaporating surface, the oropharyngeal partition and the mouth-prop are simultaneously removed, and a small roll of gauze is placed over the bleeding sockets. The patient is instructed to bite down and is permitted to recover completely from the anesthesia.

During this study, all phases of this procedure were accurately timed by means of a stop watch.

Induction of analgesia was recorded from the moment the first drop of vinethene was placed upon the evaporating surface until the patient experienced dizziness.

Operating time was recorded from the instant the mouth-prop was introduced until all extractions and other surgical manipulations were completed.

Recovery time was registered from the completion of all surgical manipulation until the patient responded by answering to his name, and was able to walk from

the dental chair to an adjoining rest room unassisted or assisted by the nurse.

The statistical analysis in the accompanying table is based upon 100 consecutive, unselected and unpremedicated cases in persons ranging from 5 to 20 years of age. One to eight extractions were performed at one sitting.

In many instances, food had been taken prior to the scheduled time for extraction. Although this was never sanctioned or encouraged, the absence of postanesthetic nausea and emesis was surprising. In no case in this series has excessive hemorrhage, dry socket or painful swelling been a complication.

SUMMARY

Anesthesia that is particularly adapted to facilitate surgical operations and provide pain relief during extractions is not developed to the extent that any single method or drug is entirely satisfactory. A procedure that is safe, convenient and economical and which may be easily carried out by inhalation technic should find wide use.

Vinethene, recently introduced volatile agent for inhalation narcosis, was used in 100 cases. It presented certain advantages such as convenience, rapid, pleasant induction and recovery, simplicity of apparatus and absence of untoward postanesthetic reactions or complications.

The procedure employed gave excellent satisfaction in this small series of cases. It is recommended for more extensive trial. The large majority of patients treated in this study were children. Such patients may not be likely candidates for conduction anesthesia and may require an exacting technic when inhalation methods are employed. The procedure employed was found to supply a definite need for a simple and safe method for pain relief in younger patients treated in an ambulatory clinic.

The study was completed under the direction of E. A. Rovenstine, M.D., and Leo Winter, M.D., D.D.S., directors of the Division of Anesthesia and Department of Oral Surgery, respectively, in Bellevue Hospital.

BIBLIOGRAPHY

1. Novitzky, Joseph: Sensory Nerves and Anesthesia of Teeth and Jaws. *Mod. Dentistry*, 5:5-10, April 1938.

2. Wittke, R. C.: Inner Filaments of Inferior Alveolar Nerve. *Mod. Dentistry*, 5:27-28, April 1938.

3. Waters, R. M.; Rovenstine, E. A., and Guedel, A. E.: Endotracheal Anesthesia and Its Historical Development. *Anesth. & Analg.*, 12:1-8, September-October 1933.

4. Waters, R. M.: Carbon Dioxide Absorption from Anesthetic Atmospheres. *Proc. Roy. Soc. Med.*, 30:11, October 1936.

5. Rovenstine, E. A.: Anesthesia: Organization for Teaching. *Anesth. & Analg.*, 16: 3-7, November-December 1937.

6. Courville, Cyril B.: Asphyxia as Consequence of Nitrous Oxide Anesthesia. *Medicine*, 15:129-245, May 1936.

7. Courville, C. B.: Pathogenesis of Narcosis of Gray Matter Following Nitrous Oxide Anesthesia. *Ann. Surg.*, 107:371-379, March 1938.

8. Henson, C. W.: Relative Safety of Anesthetics. *Anesth. & Analg.*, 16:345-358, November-December 1937.

9. Ruigh, W. L., and Major, R. T.: Preparation and Properties of Pure Divinyl Ether (Vinethene). *J. Am. Chem. Soc.*, 53:2662-2671, July 1931.

10. Ravdin, I. S., et al.: Further Experiences with Vinethene Anesthesia. *Anesth. & Analg.*, 17:176-180, May-June 1938.

11. Beach, E. W.: Additional Further Clinical Investigations with Divinyl Ether as an Anesthetic Agent in 1,882 Cases. *Anesth. & Analg.*, 17:90-92, March-April 1938.

12. Bosworth, L. L.: Vinethene-Oxygen-Air: New General Dental Anesthetic. *D. Survey*, 14:1065-1066, September 1938.

13. Present Status of Vinethene. (Report of Council on Pharmacy and Chemistry). J.A.M.A., 109:656, August 28, 1937.

14. Lyons, S. S.: Vinethene Burn. J.A.M.A., 111:1182-1183, October 1, 1938.

INCOMPLETE AND COMPLETE JAW ANKYLOSIS

By MATTHEW N. FEDERSPIEL,* D.D.S., M.D., F.A.C.S., Milwaukee, Wis.

STIFFNESS in the region of the temporomandibular joint, varying from a limitation of motion to absolute immobility, is usually spoken of as ankylosis. The terms true and false and complete and incomplete are employed to designate two groups in which a variety of forms are classed.

True, or intra-articular, ankylosis is caused by consolidation of the joint. In false, or extra-articular, ankylosis, more or less movement exists and the condition is caused by rigidity of the surrounding structures.

From a clinical standpoint, a fixed or limited movement of the lower jaw usually should be spoken of as intra-articular or extra-articular, the term indicating whether the disease is within or outside the joint. The term intra-articular ankylosis should be used to refer to a change in the articular relations in one or both joints, which may be largely due to an inflammatory action. Inflammation within the joint calls for consideration of the character and nature of the disturbance, as to whether it arises from a local or a constitutional condition; which makes a great difference in the prognosis.

With a local cause such as a blow, fracture or other form of trauma, prognosis is usually favorable. A constitutional cause, such as syphilis, rheumatism or suppuration caused by invasion from the teeth or middle ear or from metastasis in septic arthritis, calls for more extensive treatment and care to obtain a fair movement of the joint.

Septic arthritis in early childhood, if left untreated, causes an extreme ankylosis of the jaw. I have such a case now under my care, in a man 32 years of age.

CASE 1.—*History.*—The only information available was that the patient had had an abscess involving the region of the left joint when he was 6 years of age and since that time the jaw has been ankylosed.

Examination.—There was no movement of the mandible. The few teeth that had erupted were undergoing considerable decay and most of the teeth remained embedded in the upper and lower jaws. The mandible had not developed and there was marked shortening, so that the chin receded. (Fig. 1.) The lower incisors and one upper lateral incisor had sloughed out, and one upper central incisor had just a fragmentary root embedded in the alveolar structure. Figure 2 shows the jaw fixed and the alveolar crest in contact where the teeth have not erupted. The patient was poorly nourished because the only way he could partake of food was by stuffing it between the vacant spaces where the teeth had been lost from extensive decay. The roentgenogram of the left side revealed obliteration of the entire temporomandibular joint with an extensive area of sclerosis of the bone from persistent irritation the result of the infection that he had. (Fig. 3.) In the roentgenogram of the right side, the outline of the temporomandibular joint could be seen, but part of the zygoma had been pushed down and considerable sclerotic bone had formed in the region of the mastoid cells. (Fig. 4.)

Operation.—About six months ago, the left side was operated on. The neck of the condyle and the coronoid process were re-

*Professor of oral and maxillofacial surgery, Medical and Dental Schools, Marquette University.

Read before the Section on Oral Surgery, Exodontia and Anesthesia at the Eightieth Annual Session of the American Dental Association, St. Louis, Mo., October 26, 1938.

moved. Thereafter, the jaw could be partly opened.

Outcome.—On account of the patient's poor physical condition, further operative work was postponed until he should gain weight. He is now able to open his mouth about 2 cm. and his physical condition is improving.

Since the jaws had been fixed for over twenty-seven years, the right side had undergone considerable osseous changes, yet the patient is able to obtain some movement of the right joint. After osteoarthrotomy, he should be able to open

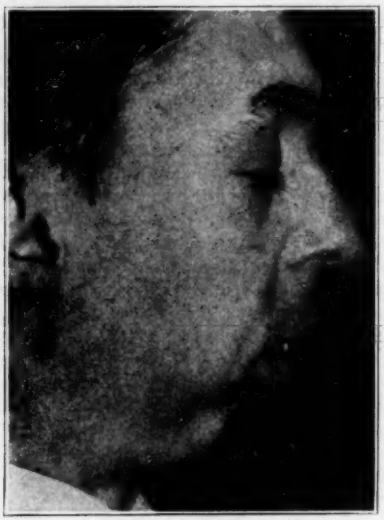


Fig. 1 (Case 1).—Complete bony ankylosis with undeveloped mandible. The extreme recession of the chin developed from an abscess involving the temporomandibular joint when the patient was 6 years of age.

his mouth wide enough so that the diseased, broken down and impacted teeth can be removed and the mouth can be prepared for artificial teeth. The facial appearance can, of course, be greatly improved by inserting a cartilage in the chin.

An acute inflammation may be so severe as to quickly develop suppuration and result in destruction of the parts; or it may be so slight as to cause temporary congestion and slight pain on movement of the joint and, after a few hours of rest, may disappear. Therefore, we must keep the patient under careful observation and govern the treatment by

Fig. 2 (Case 1).—Retraction of right cheek, showing fixed jaw.

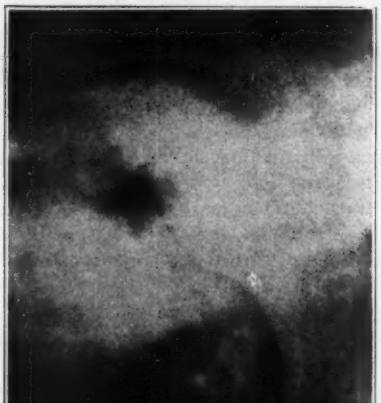


Fig. 3 (Case 1).—Temporomandibular area of left side. The extensive bone sclerosis is a result of the persistent abscess that the patient had in childhood.

the progress of the invading disease, depending, of course, on the indications of each special case.

To limit or control inflammation is, of course, the principle of cure. If the inflammation, in defiance of palliative treatment, passes onward in its terrible destruction without early drainage, the danger of ankylosis is more probable. Therefore, it is of the utmost importance not to delay in opening the joint, so that the imprisoned pus may be released. After the acute condition is overcome, the inflammation is often quickly terminated. It is the delay in recognizing the destruction resulting from the process of inflammation that may be responsible for the termination of the condition in an ankylosis of the temporomandibular joint.

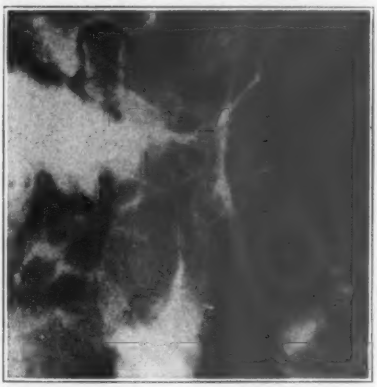


Fig. 4 (Case 1).—Lengthening of coronoid process.

Case 2.—A young man, aged 20, had a coronal abscess involving a partially impacted mandibular third molar which was lying in anteversion. The abscess had involved the peridental membrane and then destroyed the cancellous structure of the ascending ramus, extending upward to the condyle and then finally breaking into the joint. The doctor in charge advised against removing the impacted third molar during the acute stage. Because of this delay and failure to establish drainage, the infection extended to the temporomandibular joint. Several months later, the molar was removed and drainage established. This, of course, did not remedy the inflammatory condition involving the joint. The patient had developed a limited motion of the jaw, which became more progressive until the joint remained fixed and, in order to relieve the condition and make the mandible again movable, it was necessary to excise the condyle.

In traumatic injuries of the temporomandibular joint, intra-articular hemorrhage followed by infection is probably the most outstanding factor in an ankylosis. Especially is this true when the condyle is pushed through the capsule of the socket. I have never had a case in which it was possible, after reduction of the dislocated and fractured condyle, to avoid limitation of motion. In such injuries, it is advantageous to the patient to have the displaced condyle removed,

Fig. 5 (Case 3).—Condylar process removed from patient, aged 17. After operation, there was no displacement of the lower jaw nor disfigurement of the facial outline. Function was normal.

if it has torn through the capsule, and the jaw bones immobilized by wiring the upper and lower teeth so that the occlusion is normal. I have had several cases in which this was done, and the results have always been gratifying.

Case 3.—*History.*—A youth, aged 17, who was injured in an explosion of an air compressor in a garage, had a laceration about 2.5 cm. in length beneath the chin and a fracture of the neck of the right condyle, which was displaced through a tear in the external capsule, and resting in front of the eminentia articularis.

Examination.—The case was seen forty-eight hours after the accident. The patient had a beautiful set of teeth. The jaw bone had shifted laterally to the side of the fracture.

An exploratory incision disclosed that because of the destruction of the capsule and the displacement of the condyloid process, it would be advantageous not to attempt to repair the injury by an open reduction of the fracture.

Operation.—The condyloid process and the intra-articular hematoma were removed and the wound was closed. The mandible was then placed in such a position that the teeth were in correct occlusion and was immobilized by intermaxillary ligation to assure complete rest for one month.

Fig. 6 (Case 4).—Shifting of mandibular arch and distortion of facial outline following fracture of condyloid process, which was torn out of its socket.

Outcome.—After the wires were removed, the jaw remained in its normal position, and at no time has the patient experienced a limited motion of the jaw bone. He made an uneventful recovery. (Fig. 5.)

When it is necessary to remove the condyloid process, it is of the utmost importance that the jaws be immobilized in the correct mesiodistal relationship. Unless this is done, the mandible will drift toward the fractured side, a dento-facial deformity and malocclusion of the teeth resulting.

Case 4.—A young man, while blasting rocks, fractured the neck of the condyle on the left side so badly that the condyle was torn out of the glenoid fossa, and lying in front of the eminentia articularis. There was also a fracture between the lower left bicuspid and lateral incisor and another fracture between the lower right second bicuspid and first molar. The patient was seen seven days after the injury, and by this time an infection had developed at the fractured points, with pus flowing freely. The left, lower lateral and left central incisors were knocked out at the time of the explosion and pus was oozing from the sockets of the lost teeth.

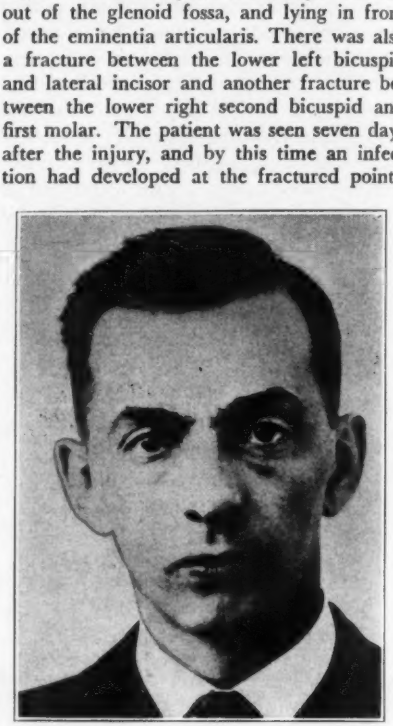


Fig. 7 (Case 4).—Improvement of facial outline after removal of condyloid process and healing of jaw.

A subperiosteal abscess had developed below the chin. A probe introduced into either one of the sockets would pass through the bone into the subperiosteal abscess. In other words, osteomyelitis of the mandible had developed. Because the neck of the left condyle was fractured and the condyle torn

from the socket, resting and lying in front of the eminentia articularis, the jaw shifted backward, causing the facial lines to be very much distorted. (Fig. 6.) The condyle was removed, and the fractured parts of the mandible were immobilized with orthodontic appliances and given the usual care to ensure a correct relation of the upper and lower teeth. About six weeks after this treatment, the patient was dismissed. The jaw bone remained in a normal position. (Fig. 7.)

Case 5.—*History.*—A man, while working in a gravel pit, was hit on the side of the face with a steam shovel, a fracture of the zygoma resulting. The wound over the zygoma was approximately 4 cm. in length. His family physician performed an open reduction and treated him for several weeks in order to clear up the slight drainage of pus. After the wound healed, the patient noticed a gradual diminishing of the jaw movement. About six weeks later, he could open his mouth only about 6 mm. (Fig. 8.)

Fig. 8 (Case 5).—Jaw ankylosis following injury of coronoid process and malar bone.

Examination.—Roentgenograms of the joints disclosed no osseous changes.

Operation and Outcome.—Because of the nature of the injury, in the healing of the infected wound, it seemed that there probably was scar tissue formation of the temporal muscle where it converges toward the coronoid process of the mandible, and that this scar tissue was attached to the inner surface of the zygoma, which had been pushed slightly inward from the fracture. An exploratory operation confirmed this opinion. After the removal of the coronoid process, separating the temporal muscle from its attachment, and the removal of the scar tissue, the patient made a complete recovery, and he now can open his mouth without any difficulty. There is, however, some limited movement, which is gradually subsiding. The few remaining upper teeth were removed at a later time and the patient now wears an artificial denture. (Fig. 9.)

Fig. 9 (Case 5).—Extent of mouth opening after removal of coronoid process which, from scar tissue, had become attached to malar bone.

As I have said before, after a jaw has remained fixed for a year or longer because of cicatricial ankylosis, osseous changes may take place within the joint especially if the patient had developed previously an osteomyelitis of the jaw bone, probably from a compound fracture. The next case illustrates this very clearly.

Case 6.—*History.*—A man, aged 40, a milk wagon driver, was injured in an automobile collision, having a compound fracture of the angle of the jaw and a simple fracture of the neck of the condyle on the left side.

About two years after this injury, the jaw opening gradually diminished until when the mouth was open, the distance between the upper and lower incisor teeth was about 9 mm. Because of this deformity, the patient could insert his artificial teeth only with great difficulty.

Examination.—The x-ray film clearly showed bone sclerosis in the region of the temporomandibular joint, and when the patient was examined, it seemed certain that a resection of the condyloid process would relieve him of the incomplete ankylosis.

Operations.—The resection was performed, an incision being made above the zygoma and in front of the ear, following the Blair

Fig. 10 (Case 6).—Ankylosis of jaw resulting from infection following injury to temporomandibular joint in auto accident.

technic. After this was done, the mouth could be opened with a dilator, but the jaw movement was still rigid and stiff. The patient was instructed to stretch his mouth regularly with dilators. Nine months later, he reported that notwithstanding this form of treatment, the jaw movement was becoming more limited as time went on. Figure 10 shows the limited opening of his mouth.

In this case another operation was performed, an incision being made beneath the angle of the jaw. The masseter muscle was split and all of the soft structures were raised, the entire ascending ramus being exposed so that the coronoid process and the region of the joint were easily visible. The coronoid process was removed at its base, and it was found that considerable new bone had reformed at the site of the previous operation. For fear there would be more new bone formation, the Risdon operation of suturing the masseter and internal pterygoid muscles together was followed so that the ascending ramus was embedded pocket-like between these two muscles. The result was very satisfactory. (Fig. 11.)

The approach for resection of the joint

Fig. 11 (Case 6).—Appearance of patient after removal of coronoid and condyloid processes and suture of masseter and internal pterygoid muscles over stump of ascending ramus. The jaw now moves freely and easily.

or coronoid process is, I believe, much easier if an incision is made beneath the angle of the jaw, as illustrated in Figure 12. The visibility for the structures to be operated on is better; there is less danger of injuring the seventh nerve, and drainage, if necessary, is better. In the last few years, I have followed this method and I find the results more satisfactory.

It is not uncommon to find disturbances of jaw movement from deep injection for the purpose of obtaining anesthesia. Not that the anesthesia is the cause, but the carrying of bacteria into the deeper structures, developing an acute inflammation followed by destruction of the tissue involved, may result in a limited jaw movement or sometimes a complete trismus. Cases 7 and 8 are notable examples of such a condition.

Case 7.—*History.*—Miss A. had a lower molar extracted. Shortly after the extraction, she experienced a painful swelling in the retromolar area and the region of the anterior pillar. After several days, the jaw became fixed. A week or so later, the inflammatory symptoms subsided, but the jaw remained fixed. The condition continued for three months notwithstanding many attempts to wedge the jaws apart.

Fig. 12 (Case 6).—Risdon operation for resection of joint in ankylosis.

Examination.—There was nothing to indicate any physical or mental disturbance which might cause the ankylosis. The patient could open the jaws approximately 3 mm. (Fig. 13.) She was persuaded to undergo ether anesthesia, and it was possible, under forcible dilatation, to wedge the jaws apart sufficiently to permit a careful exploration of the mouth and throat. During dilatation, a bulging of the internal pterygoid muscle on the left side was noted. The bulge felt semi-hard, with some fluctuation.

Operation and Treatment.—An exploratory incision of the mass revealed a thick purulent inspissated pus oozing from the wound. When this was evacuated, the jaw could be dilated to the normal opening. The patient was advised to practice opening the mouth as wide as possible and to chew large pieces of gum.

Outcome.—Under this form of simple home care, the jaw movement became normal in six weeks. (Fig. 14.)

Case 8.—*History.*—Mrs. W. had an incomplete ankylosis of the lower jaw following the extraction of the right lower third molar under local anesthesia. She developed a swelling near the angle of the jaw a few days after the extraction. After two weeks, the pain subsided and the swelling decreased to the size of a hickory nut, localizing at the posterior edge of the masseter muscle. She had been given the usual palliative treatment, such as hot fomentations and the use of electric pads. Dilatation was attempted without an anesthetic, but because of the excruciating pain, this was discontinued. When she was first seen, approximately six months had passed since she had developed the partial ankylosis. (Fig. 15.)

Fig. 13 (Case 7).—Jaw ankylosis of three months' duration, following conductive anesthesia for extraction of molars.

Operation and Outcome.—Under ether anesthesia, the mass was opened and a thick

purulent secretion evacuated. The jaws were then forcibly dilated and the wound was drained for several days. This patient too was advised to institute the usual postoperative care of dilatation and gum chewing. Three weeks later, the jaw opening was normal. (Fig. 16.)

A prolonged trismus, of a year or longer, untreated may bring on sufficient osseous changes within the joint to require a radical condyloid resection for relief. I had a patient with this condition following postextraction under block anesthesia. Frequent dilatation and palliative care did not improve the partial ankylosis. Because the patient could open the mouth approximately 1.5 cm. and had become accustomed to this limited opening of the jaws, operative care was refused.

Fig. 14 (Case 7).—Opening of mouth possible after drainage of pus from beneath internal pterygoid muscle.

Osteomyelitis of the jaw and deep infections of the surrounding structures with an extensive perimaxillary phlegmon should always be regarded as possible sources of sufficient destruction of the masticating musculature to terminate in some form of cicatricial ankylosis; therefore, early free drainage should be established in such cases, in order to prevent a further invasion of the imprisoned pus.

Case 9.—*History.*—Several years ago, a man, aged 31, came in with the complaint of a slight pain in the region of the mandibular third molar on the left side complicated by inability to open his mouth. Four years previous to the present time, he had had pain periodically in the angle of the mandible radiating upward into the temporal region. During the last year, he had noticed a slight swelling of the soft structures beneath the jaw bone, and he found it very difficult to open his mouth. (Fig. 17.) This was very annoying and caused him anxiety and worry. He feared that he might develop lockjaw.

Fig. 15 (Case 8).—Partial ankylosis of six months' duration following removal of lower third molar.

Examination.—The teeth appeared to be clean, and there was no evidence of gingival irritation. The patient could open the mouth to the extent that a mouth mirror could be inserted, but this caused considerable pain. The occlusion was anatomically correct, and the only missing teeth were the mandibular second and third molars. There was a slight enlargement of the submaxillary gland on that side. The white

blood count was 12,500 and the temperature 99.6. A roentgenogram of the left mandible revealed a displacement of the third molar, which was lying in the lower border of the mandible. (Fig. 18.) The area surrounding the tooth above the crown gave evidence of undergoing degeneration, probably caused by the presence of a follicular cyst, which was undergoing inflammatory changes.

Fig. 16 (Case 8).—Opening of mouth possible after drainage of pus from beneath masseter muscle.

Fig. 17 (Case 9).—Fixation of jaw of one year's duration.

Operation and Outcome.—The tooth was removed extra-orally. It was embedded in a mass of necrotic tissue with remnants of an old cyst. The pus had burrowed through the bone and had collected beneath the masseter muscle. This accounted for the trismus so long present. Postoperative dilatation for several weeks afforded complete relief. The jaw now moves freely and easily. (Fig. 19.)

Deep radium treatment of neoplasms involving the jaw, especially in the retro-molar and buccal-pharyngeal areas, may cause sufficient destruction of the soft structures to result in healing with excessive formation of scar tissue. This results in a fixed jaw.

Fig. 18 (Case 9).—Misplacement of third molar with infected follicular cyst, causing jaw to remain fixed for over a year.

Fig. 19 (Case 9).—Extent of opening of mouth possible.

Case 10.—*History.*—A boy, aged 7, now under care, according to the parents, at 2 years of age had had treatment with radium for the destruction of a neoplasm in the

retromolar area. Since that time, there had been a gradual diminishing of the jaw opening, and at the age of 7 years he could open the mouth only about 3 mm. (Fig. 20.)

Examination.—On retraction of the lip and cheek on the right side, the fibrous thickened scar tissue was plainly visible.

Operation.—Dilatation could not be accomplished under ether anesthesia until the fibrous bands were separated by a deep incision. The scars were cut out and a plastic repair made by transplanting mucous membrane over the open wound.

Outcome.—Healing was uninterrupted and

Fig. 20 (Case 10).—Ankylosis of jaw following radium burn in retromolar area.

the patient is now able to open his mouth approximately 2.5 cm. (Fig. 21.) Further study in his case reveals osseous changes in the joints. Forcible dilatation fails to open his mouth any farther.

As I am undecided whether to form a resection of the condylar process, I am keeping him under observation in order to make a decision at a later time.

BIBLIOGRAPHY

BLAIR, V. P.: Surgery and Diseases of the Mouth and Jaws. St. Louis: C. V. Mosby Co., 1912.

BROPHY, T. W.: Oral Surgery. Philadelphia: P. Blakiston's Son & Co., 1915.

BROWN, G. V.: Oral Diseases and Malformations. Philadelphia: Lea & Febiger, 1912.

GARRETSON, J. E.: A System of Oral Surgery. London: J. B. Lippincott & Co., 1881.

HORSLEY, J. S., and BIGGER, I. A.: Operative Surgery. St. Louis: C. V. Mosby Co., 1937.

KEEN, W. W.: Treatment of War Wounds. Philadelphia: W. B. Saunders Co., 1917.

Fig. 21 (Case 10).—Improvement in jaw opening after removal of scar tissue and transplantation of mucous membrane.

KRAUSE, FEDOR; HEYMANN, EMIL, and EHRENFRIED, ALBERT: Surgical Operations. New York: Rebman Co., 1917.

PADGETT, E. C.: Surgical Diseases of the Mouth and Jaws. Philadelphia: W. B. Saunders Co., 1938.

RISDON, FULTON: Ankylosis of the Temporomandibular Joint. J.A.D.A., 20:1933, November 1934.

THOMA, K. H.: Clinical Pathology of the Jaws. Springfield, Ill.: Charles C. Thomas, 1934.

1403 North Astor Street.

RADIODONTIC ASSISTANCE IN REPLACEMENT PROBLEMS

By Clarence O. Simpson, M.D., D.D.S., St. Louis, Mo.

In addressing the Section on Partial Denture Prosthesis, it may be assumed that natural teeth are not prohibited from discussion and that those in attendance believe that normal, useful teeth should not be sacrificed for the sake of constructing full dentures. The frequency with which patients retaining many serviceable teeth are advised to have all of them removed suggests that dentists have concentrated too much on full denture prosthesis and neglected the study of partial replacements. As one interested in, rather than participating in, restorative dentistry, a radiodontist may have pertinent observations regarding the problems involved.

The mechanical phases of restorative procedure have consistently advanced from the prevalent standard of twenty years ago. Methods have been established which permit accurate casting of large and intricate appliances. Hydrocolloids and artificial stone have revolutionized the making of impressions and models for partial dentures. Precise attachments have been devised for replacements. There have been voluminous discussions of the indications and means for increasing the vertical dimension of the face. However, developments have proved that factors other than mechanics must be considered, because many of the replacements have become orthodontic or exodontic appliances. Perhaps enthusiasm in technical advances has contributed to the neglect of radiographic aid in considering biologic aspects. It may be coincidental, but it has been observed that some of the most proficient restorative experts have the most inefficient radiodontic service and do not realize that handicap.

Possibly, man can serve only one master and it is futile to plead with restorative enthusiasts for efficient radiodontic service, but this opportunity will be utilized for that purpose. The appeal lacks the selfish interest of increasing the compensation or decreasing the cost and labor of production. The most to be expected from arguments for better service entailing additional effort is acquiescence of the multitude, but only a few earnest converts. The typical restorative expert is confident, arbitrary and aggressive. He is vociferous in proclaiming perfection for his present principles and practice, although they have been changed repeatedly and are condemned by other equally confident restorative engineers. He may be a wizard in detecting and correcting occlusal abnormalities, or he may have only the habit of advising "bite-raising" projects for most adult patients. He may have a specially trained technician to execute the master craftsmanship, but any one can make the radiographic examinations constituting a survey of the structures which are to support the restorations. This is not sound engineering, for when the foundation is deficient, the structure is doomed.

It is useless to plead for a service un-

Read before the Section on Partial Denture Prosthesis at the Eightieth Annual Session of the American Dental Association, St. Louis, Mo., October 25, 1938.

less its definite value is demonstrable. Hence, a brief analysis of the practical information disclosed radiographically, most of which is unobtainable by any other means. For restorations and replacements, it is first necessary to determine which teeth can be safely retained. Any one controlled by the pulpless tooth phobia will sacrifice harmless teeth to prejudice, because the pathogenicity of all pulpless teeth has not been proved. One guided only by vitality response will retain septic teeth, the pulps of which are degenerating but are still sensitive to electric and thermal tests. A more rational method of differentiating the status of teeth is obligatory. By adequate radiodontic examinations, the periapical condition, which is the most reliable index to the pathogenicity of pulpless teeth, could be determined, and vital teeth with septic degeneration of the pulp could be identified. Inadequate radiodontic examinations are unlikely to supply this information and are very liable to cause errors of omission or commission.

Before attaching superstructures to increase the vertical dimension and before utilizing teeth for bridge abutments or removable appliances, the natural resistance to stress should be estimated with all possible accuracy. The stress resistance of teeth is dependent upon the size and form of the roots, the ratio of bone support to the length of the tooth and restoration, the position of the teeth and the structure of the supporting bone. Although the length of roots is usually proportionate to the length of the crowns, this is an unsafe assumption, as there are conspicuous deviations revealed in radiographs. The tendency to disproportionate root length may be throughout the denture or confined to only a few of the teeth. The ratio of bone support to the length of the tooth and restoration establishes the leverage of the stress on the support, which is markedly increased by extensive superstructures. It might be supposed that the position of teeth could be ascertained by the position of the crowns, but deceptive inclinations affecting stress resistance are disclosed by the radiograph.

Alveolar bone differs greatly in thickness, pattern and density. The functional activity of the periodontal membrane and the density of the alveolar crest are important factors in stress resistance. Hypercalcemic and hypocalcemic bone is an arbitrary classification which ignores reaction to physiologic stimulus, pathologic invasion and trauma. The densest bone will succumb to excessive stress and marginal infection, and sparsely calcified types with a predominant organic content display a characteristic resistance to functional abuse. Demineralization and remineralization of bone and that alveolar bone is an index of endocrine function are unproved theories which offer no practical solution of restorative problems.

In judging the radiability of edentulous areas, the buccolingual atrophy of the alveolar process and the altered pattern of regenerated bone in the alveoli must be considered. An edentulous area, included with adjacent teeth in a radiograph, will appear quite radiolucent if there is sufficient exposure for the teeth. Only three-fourths as much exposure is generally required for completely edentulous regions as if teeth were present. An emphatic indication for radiographing apparently edentulous regions is to exclude the presence of root fragments, pathologic involvements, unerupted teeth, foreign materials and irregularities of the bone requiring surgical preparation. Accurate and distinct radiographic images are essential to distinguish the stress-resisting factors discussed. Errors of angulation distort the form and position of roots. Incorrect technical procedure and unsuitable films misrepresent the character of bone structure. The principal cause for misinterpretation of dental radiographs at present is the use of films which produce ex-

cessive contrast and insufficient detail.

The rational preparation of vital teeth for restorations must be done with vigilance for pulp protection. The location of pulps in relation to the dentino-enamel juncture varies so greatly that it should be observed before and sometimes during preparation. Radical preparation with disregard of pulp protection is liable to cause continued discomfort from restorations and ultimately cause the death of pulps. Ultraconservative preparation restricts the strength of restorations, which may result in fracture or displacement of them. The logical precaution is to have bitewing radiographs which show the approximate relation of pulps to the dentino-enamel juncture, except on the labial or buccal and lingual sides. Particular scrutiny should be given to the recessional horns of pulps which are difficult to trace through the radiopacity of the surrounding crowns.

Despite the refinements in the production of cast restorations, the gingival margin remains a difficult location in which to secure perfect adaptation. The fit of a casting to all other margins does not exclude a discrepancy at the gingival margin, and instrumental examination in this location is subject to optimistic error. With restorations in place but before cementation, bitewing radiographs should be made at angles differing 10 degrees mesiodistally to reveal any gingival deficiency or projection. After such inspections, some excellent operators have been chagrined at the imperfection of their castings. It may sooth the conscience to classify one's own failures as recurrent caries and the failures of other operators as defective restorations, but it is better to take all precautions in excluding defects. There is sufficient risk from individual restorations to warrant this inspection, and with abutments the multiple risks and extensive replacements make it imperative.

It is especially important to keep restorations and replacements under observation by periodic radiographic examinations. Caries, alveolar destruction and periapical infection are more easily arrested in the incipient stages which can be revealed by the radiograph. When the destructive processes are realized by the patient or discovered by the customary clinical examination, the condition is usually too far advanced for conservative measures. Dentists should accept the responsibility of reasonable maintenance, and reasonably they should be held responsible for negligence in detecting destructive developments which are remediable and cause premature failure of restorations and replacements. Most patients appreciate and cooperate in periodic inspections, which inspire confidence and enhance the professional reputation of dentists.

The requirements of adequate radiodontic service may be defined as determining, within the anatomic and radiographic restrictions, the condition of and around each tooth and of the edentulous areas. These requirements are exacting and a tremendous distinction from merely making "hit or miss" radiographs of all the regions, and they grant no compromise for restrictions in skill or diligence. For a general radiodontic examination, sixteen periapical and two posterior bitewing radiographs are the minimum specifications, and almost twice that many may be necessary for sufficient information.

The images must be approximately the true size and form of the teeth; there should be no evidence by magnification of movement during exposures, and by suitable illumination the contrast and density should be such as will reveal the structural detail of both the bone and the teeth. With rare exceptions for anatomic restrictions, the *lamina dura* should be visibly registered around all the roots, which necessitates different views of many teeth. Adequate radiodontic examinations entail sound technical pro-

cedure with ample skill and experience to apply it. It is a definite advantage to have the films developed during the progress of the examination, so that corrections and verifications can be made while all the factors are in mind. For the most efficient restorative dentistry and partial denture prosthesis, adequate radiodontic service is obligatory. If it is not obtainable from radiodontists, restorative dentists must be qualified to render this service. Radiodontics can be learned the same as other exacting procedures, but only by earnest study, diligent practice and keen discrimination.

607 North Grand Boulevard.

PHYSICOCHEMICAL STUDIES OF ENAMEL

(II) ORGANIC CONSTITUENTS OF ENAMEL— A POLAROGRAPHIC STUDY

By Oscar Kanner, A.M., M.D., Chicago, Ill.

THE polarograph, an instrument invented by Heyrovsky, of Prague, analyzes solutions both qualitatively and quantitatively by means of a dropping mercury electrode. Although this very useful electrochemical method is relatively new, since 1922 several hundred papers dealing with polarographic investigations have appeared.[1] As far as I know, none of these papers deals directly with dental research.

Since not only workers in the field of dentistry, but also chemists and even electrochemists are not yet sufficiently acquainted with polarographic methods, it appears to be appropriate to discuss these procedures. However, only the general principles and the most important applications will be explained, without going into detail about the underlying physical theories.

The liquid to be examined is electrolyzed by means of a steadily increasing electromotive force, ranging from 0 to 4 volts. The electrodes are made of mercury. The anode consists of a relatively large mercury surface placed under the liquid to be analyzed. The cathode is made of drops of mercury which fall at regular intervals (about three seconds) into the liquid from a narrow capillary dipping into it. Because of its large surface, the anode is practically non-polarizable, but the small mercury drops falling from the capillary are polarized when an electromotive force acts upon the electrodes. This is one of the two reasons why the instrument is called a polarograph.

Within a short time, the polarized drop is replaced by a new one, so that accumulations of electrolytic products are avoided. An electric current, related to the electromotive force, passes through the liquid. Its intensity is governed not only by the potential difference placed upon the electrodes, but also by counter-electromotive forces due to polarization. If the circuit were a simple metallic one, the current would be proportional to the voltage laid upon the electrodes, and if this current were plotted as function of this voltage, a straight line would be obtained, in confirmation of Ohm's law; but polarization of the

From The Foundation for Dental Research of the Chicago College of Dental Surgery.

Read before the Section on Histology, Physiology, Pathology, Bacteriology and Chemistry (Research) at the Eightieth Annual Session of the American Dental Association, St. Louis, Mo., October 26, 1938.

cathode occurs, and the counter-electromotive force of polarization interferes with the increase of current intensity by an increase of the electromotive force. In this way, the current intensity is kept from increasing with the voltage, and the graph gives a straight line parallel to the axis representing the electromotive force. However, if the solution contains depolarizing agents, the current intensity increases at definite voltages, at which these elements are electrolytically deposited at the dropping mercury cathode (deposition potential). Then the current intensity does not increase indefinitely, but reaches a level of saturation, the diffusion current, so that the graph shows a step for every depolarizing constituent of the solution.

Nearly all cations are capable of causing such steps. There are also some anions capable of depolarizing activity, provided they are still susceptible to reduction; for instance, NO_2^-, NO_3^-, BrO_3^-, JO_3^- furnish steps in the presence of polyvalent cations, such as La^{3+} or Th^{4+}. Other anions may be made to produce steps by reversing the current; i.e., by anodic polarization. Besides ions, some unionized constituents, for instance, oxygen, yield steps on the graph.

It can be shown, mathematically as well as experimentally, that the voltage corresponding to precisely one-half of such a step, coincident with a point of inflexion of the curve, depends exclusively upon the quality of the constituent responsible for it, and hence offers qualitative information. The height of a step is proportional to the concentration and provides quantitative information. Thus, it is possible simultaneously to determine quite a number of constituents, qualitatively as well as quantitatively.

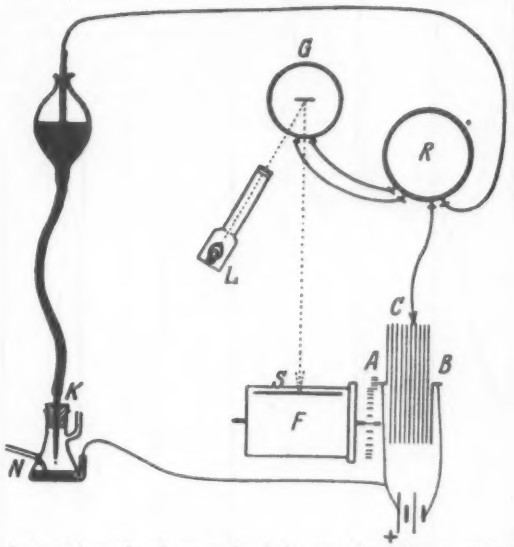


Fig. 1.—Schematic drawing of polarograph. A battery furnishes a potential of 2 or 4 volts at terminals A and B of potentiometric wire, wound on a wheel and driven by a motor. Sliding contact, C, takes off part of this potential for the circuit, containing galvanometer G, and mercury electrodes in series. R, variable shunt; K, dropping mercury cathode; N, large mercury anode; F, drum, carrying photosensitive paper and geared to wheel; S, slit to admit spot of galvanometer.

The method is so sensitive that constituents in concentrations of 10^{-5} normal or even less can still be determined quantitatively and qualitatively. The composition of the liquid does not significantly change after a determination. An analysis may be repeated any number of times.

The polarograph (Fig. 1) comprises a dropping mercury electrode, a potentiometric slide wire wound upon a rotating drum, a galvanometer and a second drum carrying photosensitive paper. The two drums, driven by a motor, are geared together. The galvanometer is connected in series with the electrodes, and its spot falls upon the recording paper through a narrow slit. The galvanometer has a sensitivity of 2×10^{-9}. By means of a variable shunt, this sensitivity can be gradually reduced to 10,000 times. The electromotive force may be provided by a storage battery. By means of this apparatus, the current intensity is continuously recorded as a function of the voltage. This is the second reason for Heyrovsky's choice of the name polarograph.

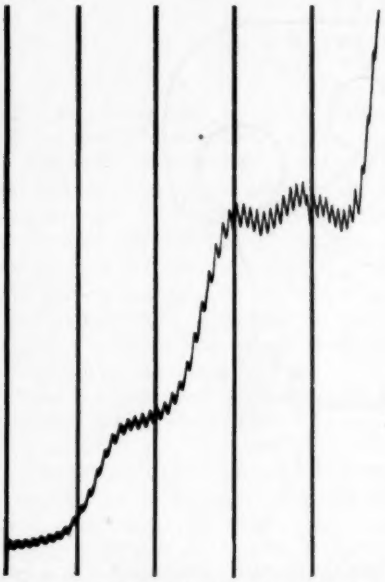


Fig. 2.—Cobalt buffer solution with blood serum in dilution 1:200; cobalt maximum suppressed. Sens. 1/200.

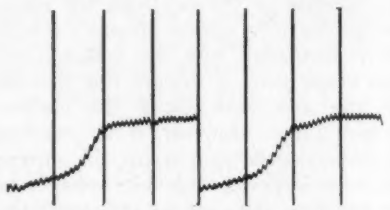


Fig. 3.—Left, curve showing behavior of aqueous extract of 200 mg. of enamel in cobalt buffer solution. Right, curve representing control experiment in which 1/40,000 cc. of blood serum was added to 200 mg. of enamel extract (of same sample). Following the relatively large cobalt step, a slight but perfectly distinct protein wave is noticeable.

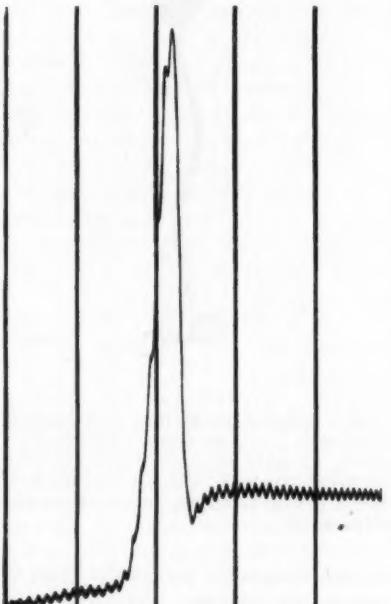


Fig. 4.—Cobalt buffer solution with full cobalt maximum. Sens. 1/200.

In addition to the described steps, the curves, called polarograms, often yield other types of information. First, under certain conditions, the curve rises as a straight line above the value of the first diffusion current and then drops quite suddenly to this level. This behavior creates a maximum on the graph. The maxima are analytically important because they are quite sensitive to the presence of surface-active substances in small concentrations. Surface-active substances, such as aromatic acids, higher fatty acids and their salts, alkaloids, proteins and other colloids, and other substances, are capable of reducing or even suppressing the maxima. Second, the reduction of hydrogen is facilitated by a number of substances by means of a catalytic action. This incidence manifests itself on the polarogram in the form of a step. Apparently, the catalytic action reduces the hydrogen overvoltage. The members of the platinum group have this catalytic property. They share it with certain biologically interesting substances, such as alkaloids (quinine) and most proteins (Fig. 2).

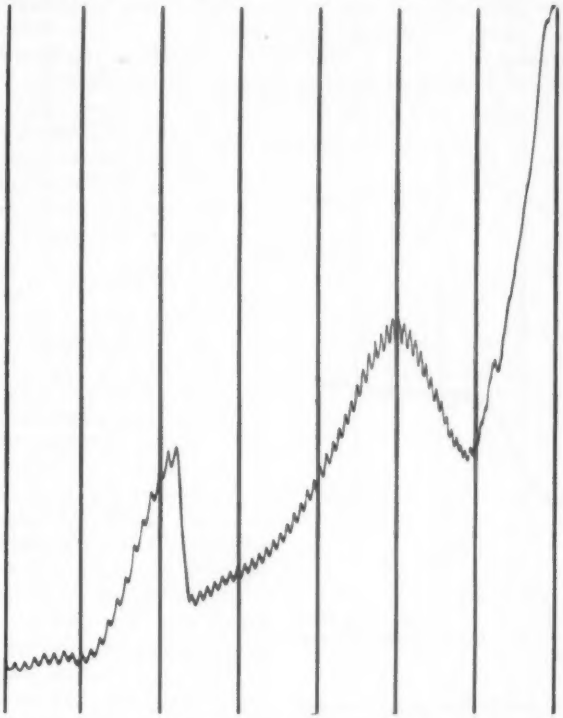


Fig. 5.—Catalytic wave in cystine solution containing cobalt. The cystine present was obtained from two gammas of human hair. The first maximum is due to cobalt; the second, to cystine.

The first part of this investigation deals with the hypothetical lymph which, according to a theory of Bodecker,[2] passes from the blood plasma of the pulp by way of the dentinal fibrils into and through the enamel. In 1934, Karshan *et al.*[3] tried to demonstrate the existence of this lymph by analyzing

aqueous extracts of powdered enamel. Hoppe-Seyler[4] had already analyzed aqueous extracts of enamel, but had failed to detect any albumin in them. Among other points, Karshan and his associates attempted to determine whether enamel contains soluble protein, as postulated by Bodecker's lymph theory. Their enamel extracts gave positive reactions for tyrosine (an amino acid present in serum proteins), but negative biuret reactions. They concluded that the positive tyrosine reaction was equivalent to the presence of approximately 0.001 cc. of "lymph" in 500 mg. of enamel, on the basis that blood plasma contains about 7 per cent protein. They attributed the negative biuret reaction to low protein concentrations in the enamel and emphasized the negative results that they obtained with solutions of egg albumin in comparable concentrations. Since these experiments do not prove the existence of a blood-plasma protein containing liquid, called dental lymph by Bodecker, the problem has been approached by means of polarographic studies.

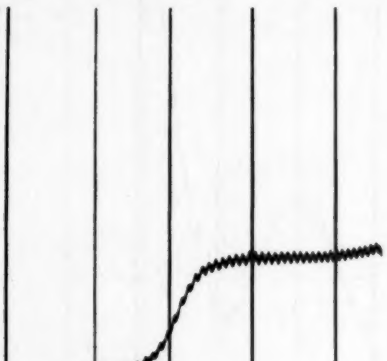


Fig. 6.—Aqueous extract of 300 mg. of enamel powder in 5 cc. of cobalt buffer solution; no protein wave; cobalt maximum suppressed. Sens. 1/200.

Enamel was prepared according to the method advocated by Rosebury,[4] by chiseling fragments from the crowns of intact teeth. Weighed amounts of fresh samples were pulverized under water, in order to avoid the denaturation by heat of soluble proteins which might be present. Samples of 0.200 to 1.000 gm. of freshly prepared enamel were secured in this way, and the aqueous extracts were examined polarographically in 5 cc. of solution in order to determine whether they contained significant amounts of blood plasma proteins. According to Karshan's estimate, plasma proteins in amounts corresponding to 0.001 or 0.002 cc. of blood plasma should have been found. Control experiments have shown that the presence of 0.0001 cc. of blood serum in 100 mg. of enamel could be detected, i.e., from five to ten times less than expected by Karshan. (Fig. 3.) However, the polarographic examination of the aqueous extracts of more than twenty samples failed to give any evidence of soluble blood plasma proteins in enamel. If enamel contained only about 0.001 per cent plasma protein, the polarograph would show it.

However, the polarograms that failed to record any plasma protein did reveal something else in enamel. The polarographic method used for the detection of protein was devised by Brdicka,[6] who found that most proteins, namely, those containing sulfur, give two catalytic steps in the presence of an alkaline ammonia buffer containing cobalt or nickel salts. This appears to be due to the presence of cystine. Proteins containing cystine furnish the characteristic steps in the presence of trivalent as well as divalent cobalt salts.

The behavior of cystine itself is somewhat different. Contrary to proteins, it writes only one step, and this only in the presence of divalent cobalt salts. This step disappears completely in the presence of trivalent cobalt ions. Figure 4 shows a polarogram of a divalent cobalt

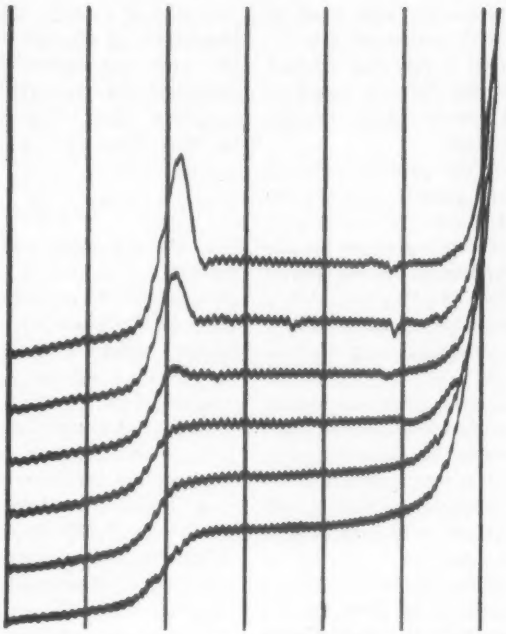


Fig. 7.—Aqueous extract of powdered enamel suppressing cobalt maximum. The curves show enamel extract in dilutions one-half, one-quarter, one-eighth, one-sixteenth, one-thirty-second and one-sixty-fourth. Dilutions one-thirty-second and one-sixty-fourth do not suppress the cobalt miximum altogether. Sens. 1/300.

buffer solution alone. This curve, like all others shown in this paper, begins at 0.8 volt. The markings of the abscissae represent distances of 0.2 volt. The first step is produced by divalent cobalt and shows a pronounced maximum.

Figure 5 depicts the behavior of cystine, as contained in 2 gammas of human hair and liberated by hydrolysis. Following the cobalt step, the cystine step also has a conspicuous maximum. Figure 6 shows the behavior of an aqueous enamel extract. It will be noted that the cobalt maximum is suppressed, and there is no evidence of a protein wave. Figure 7 shows the curves obtained with successive dilutions of an aqueous enamel extract. The proportions of the successive concentrations are one-half, one-quarter, one-eighth, one-sixteenth, one thirty-second and one sixty-

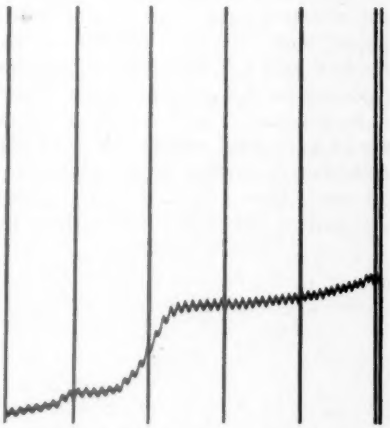


Fig. 8.—Hydrolysate of organic residue of 300 mg. of enamel powder in 10 cc. of cobalt buffer solution. The absence of a cystine wave is obvious. The cobalt maximum is suppressed. Sens. 1/200.

fourth. The appearance and gradual increase of the cobalt maximum are visible. The maximum in this case reached its normal height between the dilutions one one-hundred-twenty-eighth and one two-hundred-fifty-sixth.

The absence of the protein wave in these polarograms tends to prove the absence of blood plasma or serum protein in significant concentrations in the enamel. The elimination of the cobalt maximum indicates the presence of a surface active substance with a positive charge, perhaps an amino acid, such as tryptophan.

A second extraction of enamel powder with water shows that but a small fraction of the maximum-suppressing principle is left after a first extraction. A third extraction is usually negative with respect to the cobalt maximum, and a fourth extraction always so.

Another part of this investigation deals with organic matter left after enamel has been extracted with hydrochloric acid. Enamel powder, prepared as before, was extracted with approximately normal hydrochloric acid. The residue was separated by means of the centrifuge and extracted again with normal hydrochloric acid. The final residue was hydrolyzed with 6 N hydrochloric acid and examined in the divalent cobalt buffer, as in the case of hair. In this way, it should have been possible to determine quantities of cystine of the order of 1 gamma. More than twenty samples analyzed in this way failed to show the presence of cystine. Figure 8 gives an illustration of this behavior. The absence of cystine in enamel-hydrolysates was not altogether a surprise. Pincus[7] was unable to detect the presence of sulfur in the insoluble organic matrix of enamel.

CONCLUSIONS

1. Polarographic analyses of aqueous extracts of enamel failed to show the presence of blood plasma proteins, postulated by Bodecker's lymph theory. The method would detect as little as 0.001 per cent of soluble plasma protein in enamel.

2. Aqueous extracts of enamel contain a surface active, positively charged substance in considerable concentrations.

3. The acid-insoluble residue of enamel does not yield cystine on hydrolysis. Therefore, it appears questionable whether it should still be classified as a keratin.

BIBLIOGRAPHY

1. Collection of Czechoslovak Chemical Communications, 10, No. 2-3, 1938.

2. Bodecker, C. F.: *D. Cosmos*, 71:586, June 1929.

3. Karshan, Maxwell; Wiener, Richard, and Stofsky, Nathan: *J. D. Res.*, 14:445, December 1934.

4. Hoppe-Seyler, in Freund, E.: *Hand. der Zahnheilk.* (edited by J. Scheff.) Vienna, 1922, Vol. I, p. 460.

5. Rosebury, Theodor: *J. D. Res.*, 10:187, April 1930.

6. Brdicka, R.: *Mikrochemie*, 15:167, 1934.

7. Pincus: *Nature*, December 5, 1936.

ETHICS, THE SOUL OF DENTISTRY (II)

By J. Wright Beach, D.D.S., Buffalo, N. Y.

WHY do we desire the ethical life in our professional relations as opposed to unethical deportment? Because our applications of the laws of ethics have brought us into the higher plane of usefulness to the world of humanity and established confidence and mutual cooperation in the attainment of the richer objectives of life. Experience gleaned from the past has left this premise unchallenged, and divergence must result in a complete breakdown of the operation of equitable procedures.

Therefore, that peerless document, bequeathed us by pioneer stalwarts, our Code of Ethics, definitely eradicated the earmarks of a trade and opened the roadway of the profession of dentistry to the long, unbeaten route which has led us to the high level of kindred medical standards.

At the 1922 Session of the American Dental Association in Los Angeles, C. N. Johnson was chosen as chairman of a committee to revise the code of 1864, and as a result, we have our present embracing regulations, to which all members of the American Dental Association willingly subscribe as the Magna Charta of the profession.

Need we broadly elaborate upon the good that this document has brought to humanity through its daily use by more than 45,000 ethical dentists of the United States and her dependencies? The multifold list of major benefactions resulting from its edicts are beyond computation, for human life is protected, enriched and preserved thereby.

Within the constructive influence of our code may be found the creative and inventive developments which are responsible for the rapid growth of dentistry as a technical science. One needs but to search the uncharted route outside these limits to prove this assertion. While necessity has produced many of the most useful inventions and methods upon which our art is founded, there had evolved no systematic union of effort whereby concerted progress became definite.

Rocked in the lap of necessity, nurtured in the soul of truth, the spirit of scientific research in our profession has been carried to the furthermost outposts of civilization to cast its beneficent refulgence across the life of the world of humanity. Riches more fabulous than the jewels of potentates have been showered upon the civilized nations through the fruits of the genius of the ethical members of our profession. This heritage constitutes an imperishable asset and is the source of selfless pride and satisfaction to those who were thus privileged. Thousands of our forebears laid intricate mechanical devices upon the altar of our profession, while others gave unstintingly of time and energy in the upbuilding of ethical standards which have become our ruling precepts.

We need not go farther than the immediate past as exemplified in the life of our revered friend Dr. C. N. Johnson, who devoted more than half a century of ardent service to strengthening the structure and exemplifying the precepts of his beloved calling. Had the scales of his

career held the creative power of wealth in one balance and the career which he carried to its highest goal in the other, think you that he would have chosen the power of gold as against love and service to his profession? The entire organized world of dentistry would chorus the answer which eternally radiated from his heart:

Prince of our legion,
Great Soul of our might,
Truth was your watchword
And Justice your light.

333 Linwood Avenue.

PSEUDO-ANODONTIA ASSOCIATED WITH MULTIPLE DENTIGEROUS CYST FORMATION: REPORT OF A CASE

By THOMAS R. HADDOCK, D.D.S., Wewoka, Okla.

WHILE the literature in the endocrine, dental and genetic fields bearing on the causation of dental anomalies is relatively meager, the trend of opinion on the whole is that some particular type of endocrine dyscrasia is the most common factor in dental abnormalities. On the other hand, numerous cases have been cited in support of a genetic rather than an endocrine origin of dental anomalies.

The following case is reported because of its comparative rarity, and as a matter of record for studies in the causation of dental anomalies.

History.—A white boy, aged 14, came to the dental clinic in July, 1937, complaining of failure of eruption of his permanent teeth. He had visited a dentist the year before in an attempt to find out what was wrong. Questioning as to family history elicited nothing of importance. The past history was essentially negative with the exception of the common diseases of childhood. The patient appeared to be of average mental and physical development. The deciduous teeth had been lost by normal exfoliation, with the exception of a few which had been extracted when they became loose. There had been no pain nor swelling about the face or jaws.

Examination.—Clinical examination revealed a few scattered deciduous and permanent teeth. Of the few permanent teeth present, a number were only partially erupted, although of normal appearance. The alveolar ridges were wide and heavy, with numerous abnormal bulges. The oral mucosa was normal in appearance and quite dense and thickened in the areas exposed to mastication. (Figs. 1-2.)

Laboratory Data.—The Wassermann and Kahn tests were negative. Urine analysis showed nothing of importance. Exhaustive blood chemistry examination in this case showed nothing unusual. A biopsy was made of the soft tissues and bone overlying unerupted teeth in the lower left and upper right molar regions.

Microscopic examination showed dense fibrous tissue with occasional small spicules of bone. The fibrous tissue was fairly compact and in two areas there was a small strand of epithelial tissue of the squamous type. Immediately beneath the epithelial tissue, there was rather dense fibrous tissue. Decalcified bone showed atypical dense, compact structure. There was no evidence of a specific type of inflammation or neoplasia. The microscopic diagnosis was fibrosis. (Fig. 3.)

Radiographic Examination: The wrists

From the Department of Dental Surgery, State University and Crippled Children's Hospital, Oklahoma City, Okla.

showed normal bone development. There was no evidence of bone or joint disease. The mandible showed unerupted and misplaced teeth. A large multilocular cyst of the left ramus contained an erupted tooth. Two similar but smaller cysts were present in the right ramus. All teeth were located irregularly, some being misplaced in the maxillae. Examination of the skull revealed in both ascending rami of the mandible a thinning of the cortex and expansion of the

Fig. 1.—Maxillae showing failure of eruption of all but three permanent teeth. Only the cusps of the upper left premolar have come through the gum.

Fig. 2.—Lower arch, in which there are six teeth, in four of which only the occlusal third has erupted. The wide bulging ridges are to be noted.

bone, which, in the central portion, showed several cystic areas within which unerupted molar teeth were lying near the lower margin of the bone. Practically all the teeth were unerupted. Similar changes without cyst formation were seen in the maxillae. Two unerupted teeth were lying apparently within each antrum and projected as far as the base of the anterior ethmoid bone. Radiographic findings were consistent with a generalized retention of practically all teeth and germinal displacement of some of them. These changes were associated with multiple dentigerous cysts of the mandible. (Fig. 4.)

Intra-oral dental radiograms showed multiple unerupted and misplaced permanent teeth. There were also several retained and partially resorbed deciduous teeth. Cystic cavities were beginning to form about the crowns of several of the unerupted permanent teeth. The cyst in the lower left side

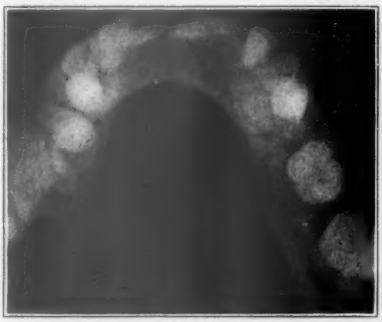


Fig. 3.—Occlusal intra-oral roentgenogram of mandible, showing large multilocular cyst of left side of mandible. The cyst on the right side is smaller and appears to be a single cavity.

Fig. 4.—Roentgenographic appearance of skull and jaws. There are estimated twenty-one unerupted and misplaced permanent teeth. Two teeth appear to be lying within the antrum, extending backward to the base of the anterior ethmoid bone. The large cysts on the right and left side are well outlined.

of the mandible was multilocular, beginning at the lower left premolar region and extending distally to the angle of the mandible. The cyst in the lower right molar region appeared to be a single cavity. (Fig. 5.)

COMMENT

This case has been presented because of the unusual abnormality existing, and because there was nothing in the patient's history or the physical or laboratory findings to suggest any etiologic factor. The patient has been under periodic observation and treatment at the University Hospital for the past eighteen months. During this time, his case has been studied from all aspects without determining anything which might offer an explanation for the dental abnormality.

There has been a rapid development of multiple cysts during the past year. Two of these cysts have been removed, but the outcome is questionable, as all of the remaining unerupted teeth are a favorable factor in cyst formation. The large number of teeth unerupted, together with their germinal displacement, makes it inadvisable to attempt their removal.

No explanation can be offered for the unusual condition present in this case. The misplacement of the germinal centers in the development of a greater number of these teeth has placed osseous structures in the direction of their eruption; which makes it impossible for them to erupt. Nevertheless, there are a number of other teeth that have no such impediment to eruption. When this case was first presented, it was thought that there might be an alveolar hyperplasia which had prevented eruption. For this reason, the bone overlying the upper central incisors was removed. The teeth were subsequently repeatedly rechecked with radiograms, but there was no change in position.

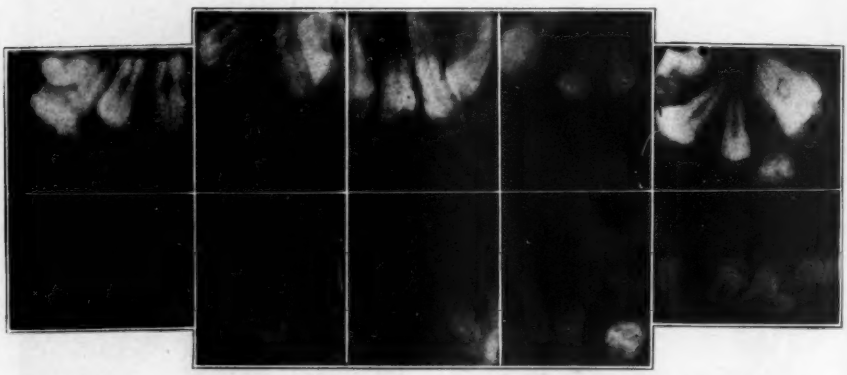


Fig. 5.—Generalized retention of practically all teeth and germinal displacement of some of them.

Microscopic examination of the investing tissues about these teeth revealed no demonstrable pathologic condition other than a slight fibrosis, which was probably due to the additional trauma of the oral mucosa from the inadequate masticatory apparatus.

No endocrine relation could be found. The bone development throughout was normal. The patient had no history of any disease which could have played a part in the anomalous development of his teeth.

Banta Building.

GRAPHIC CHARTS WHICH DEPICT THE VARIATIONS IN NUMBERS OF ERUPTED PERMANENT TEETH IN GRADE SCHOOL CHILDREN*

By HENRY KLEIN,† D.D.S. and JOHN F. CODY,‡ D.D.S., Washington, D. C.

DURING the development of their dentitions, children show a wide range of variation in the time of eruption of the permanent teeth. As a result, individuals of the same chronologic age show marked differences in the total number of erupted permanent teeth. Thus, boys aged 6 years may have none or as many as twelve and 10-year-old boys may have as few as nine or as many as twenty-eight permanent teeth.

In order to make available a graphic

NUMBER OF CHILDREN HAVING SPECIFIED TOTAL NUMBER OF PERMANENT TEETH ERUPTED*

Total Number of Permanent Teeth Erupted	Age (Years Last Birthday)										
	6	7	8	9	10	11	12	13	14	15	All Ages
	Boys										
0	22	5									27
1	8	3									11
2	24	4	2								30
3	14	5	1								20
4	29	8	—								37
5	13	7	1								21
6	31	43	4	1							79
7	7	18	10	1							36
8	8	17	21	5							51
9	2	13	10	4	1						29
10	8	39	58	19	2						126
11	2	12	25	13	7	1					60
12	3	21	52	78	42	7	2	1			206
13	—	1	29	34	30	11	3	—			108
14	—	1	12	29	21	6	7	1			77
15	—	1	2	29	34	15	4	1			86
16	—	—	3	15	21	17	5	1			62
17	—	—	—	5	18	18	6	1			48
18	—	—	—	10	16	18	9	1			54
19	—	—	—	4	16	9	13	3	1		46
20	—	—	1	2	14	27	13	1	—		58
21	—	—	—	—	6	13	8	6	3	1	37
22	—	—	—	2	13	28	24	5	3	—	75
23	—	—	—	2	9	18	26	3	2	—	60
24	—	—	—	—	11	21	20	21	7	2	82
25	—	—	—	—	3	8	26	17	10	3	67
26	—	—	—	—	3	18	40	40	26	9	136
27	—	—	—	—	2	11	19	40	40	13	125
28	—	—	—	—	1	16	74	125	107	60	383
Total	171	197	231	253	270	262	299	267	199	88	2,237

(Cont.)

*From Child Hygiene Investigations, Division of Public Health Methods, National Institute of Health, U. S. Public Health Service.

†Associate dental officer.

‡Second year dental intern.

	Girls										
0	11	3									14
1	6	2									8
2	15	3									18
3	13	1									14
4	15	5									20
5	8	6									14
6	38	26	6								70
7	7	12	1								20
8	17	25	14	—	1						57
9	6	20	8	—	—						34
10	15	51	46	4	4	1					121
11	1	15	25	3	2	—					46
12	2	28	89	60	21	3	1				204
13	1	4	30	36	16	3	2				92
14	—	2	15	24	12	7	1	1			62
15	—	2	10	31	24	6	1	—			74
16	—	—	6	15	23	6	4	1			55
17	—	—	2	13	14	7	2	—			38
18	—	—	2	19	23	12	7	2			65
19	—	—	—	11	16	15	4	1			47
20	—	—	1	8	22	11	15	3			60
21	—	—	1	4	12	18	8	2	1		46
22	—	—	—	3	12	26	16	6	—		63
23	—	—	—	6	13	12	12	5	2		50
24	—	—	—	2	18	35	17	14	3	1	90
25	—	—	—	1	7	30	18	16	6	2	80
26	—	—	—	—	8	23	47	32	9	6	125
27	—	—	—	—	2	15	29	39	22	8	115
28	—	—	—	—	9	39	113	156	122	41	480
Total	155	205	256	240	259	269	297	278	165	58	2,182

*Data derived from dental examinations of elementary school children, Hagerstown, Md.

AVERAGE NUMBER AND MAXIMUM AND MINIMUM
NUMBER OF PERMANENT TEETH ERUPTED
IN BOYS OF SPECIFIED CHRONOLOGICAL AGES
(EXCLUDING —— THIRD ———— MOLARS)
DATA DERIVED FROM EXAMINATION OF 2237 BOYS (GRADE SCHOOL)

Figure 1.

and quantitative presentation of this variability in range, the two figures included in this communication have been prepared from data given in the table.

The figures show the average number of erupted teeth for boys and for girls of different ages may be noted readily.

Thus, it may be observed that this range is greater for girls than for boys

AVERAGE NUMBER AND MAXIMUM AND MINIMUM NUMBER OF PERMANENT TEETH ERUPTED IN GIRLS OF SPECIFIED CHRONOLOGICAL AGES (EXCLUDING THIRD MOLARS) DATA DERIVED FROM EXAMINATION OF 2182 GIRLS (GRADE SCHOOL)

Figure 2.

(white line) and the maximum (upper border of black area) and minimum number (lower border of black area) of permanent teeth erupted in children in each age and sex grouping of 4,400 white grade-school children. From these figures, the range of variation in numbers and that the mean number of erupted permanent teeth is in general higher at each age for the girls. The facility with which the charts can be read and the information which can be derived from them suggest that they may serve useful purposes in dental teaching.

A PRELIMINARY SURVEY OF INORGANIC COMPOUNDS CONTAINING OXYGEN FOR USE IN VINCENT'S INFECTION

By PHILIP S. HALEY, Ph.C., D.D.S., San Francisco, Calif.

AT the suggestion of Paul J. Boyens, the following survey of oxygen-containing compounds was made in an attempt to find some easily available substances, the use of which would constitute an advantage over the commonly employed procedures in which such substances as chromic acid or a combination of chromic acid and hydrogen peroxide are employed.

The following review of chemical reactions involving hydrogen peroxide and other oxidizing agents is presented, together with brief clinical comments to indicate the possibilities for the formulation of mixtures which cause a vigorous evolution of oxygen.

1. $MnO_2+H_2O_2\rightarrow MnO_2+H_2O+O$

Manganese dioxide and hydrogen peroxide.

Manganese dioxide acts as a catalyst for the decomposition of hydrogen peroxide to water and oxygen. The manganese dioxide may be applied to the gums with a camel's hair brush. This application is followed with hydrogen peroxide.

2. Potassium permanganate and sulfuric acid and hydrogen peroxide.

The first two agents may be used in 1 per cent concentration. The chemical reaction involved may be expressed: $5H_2O_2 + 2KMnO_4 + 3H_2SO_4\rightarrow 5O + 8H_2O+K_2SO_4+MnSO_4$.

When an excess of potassium permanganate is used, the resulting mixture may be employed, freshly prepared, to rinse the mouth.

3. Potassium permanganate + hydrogen peroxide.

This mixture evolves oxygen vigorously, and a brown precipitate, probably manganese dioxide, is produced.

$2KMnO_4 + H_2O_2\rightarrow K_2MnO_4 + MnO_2 +H_2O+3O$.

It is suggested that the 1 per cent solution of potassium permanganate and the hydrogen peroxide be worked alternately around the teeth with camel's hair brushes, the saliva ejector being used so that the liberated oxygen may come in contact with micro-organisms and sloughing tissues.

4. Potassium permanganate and sodium hydroxide.

$2KMnO_4\rightarrow K_2O+2MnO_2+3O$

Addition of sodium hydroxide (4 to 6 drops of saturated solution) to about 4 ounces of potassium permanganate (1:2,000) produces a greenish brown to brown solution in about fifteen minutes. The production of this color is accelerated in the mouth, indicating a more rapid reduction of the permanganate. If a teaspoonful of this freshly prepared solution is placed in the mouth, the ejected sputum is green. As the tongue may be irritated by it, the solution should be used with discretion. Clinical investigation has not been carried to the point where an evaluation of the mixture can be made, but it is hoped that such

Read before the California Academy of Periodontology, San Francisco, Cal., August 8, 1938.

experimentation may ultimately develop more effective treatments for ulceromembranous gingivitis and stomatitis.

5. Potassium dichromate and hydrogen peroxide.

To 3 cc. of distilled water, add 3 grains of potassium dichromate and dissolve. A light yellowish color tinged with red develops. Now add 2 cc. of hydrogen peroxide. Within about one minute, ebullition of gas takes place, accompanied by a color change to dark reddish brown. Allow the solution to stand, and, in a short time, the original color returns to the solution. Litmus during this change shows no appreciable color reaction to either acidity or alkalinity. Since the ebullition of gas would be explainable by the effect of the potassium dichromate on the peroxide of hydrogen, and by the release of some of the oxygen of the dichromate, the return to the original color may be due to a partial decomposition of the dichromate into chromium oxide, Cr_2O_3, which is slightly soluble in acid media. This is provided by the peroxide of hydrogen. The evolution of the latter, when broken down into water and oxygen, removes the acidity.

The reaction may be expressed:

$$K_2Cr_2O_4 + 2H_2O_2 \rightarrow Cr_2O_3 + 2KOH + H_2O + 5O.$$

The failure of litmus here to register alkalinity may be understood by the molecular return to the dichromate condition as the oxidizing effect on the potassium of the peroxide of hydrogen was dissipated by the evolution of oxygen.

If one now powders 3 grains of potassium dichromate and mixes it with 3 grains of manganese dioxide, he will have an approximately rightly proportioned powder, which, when mixed with 4 cc. of hydrogen peroxide, will vigorously evolve oxygen. It may be also used for working between the teeth, into the interdental and paradental lesions, and for painting the tongue and buccal fields. The patient is cautioned to refrain from swallowing; and, after about thirty seconds, the fluid may be expelled from the mouth. The process may be repeated at the discretion of the operator.

A slight tongue reaction here need not deter the operator, since the effects are temporary, and the end-result seems to be a clean, pink look over the dorsum of the tongue. This is indicative of the effects of nascent oxygen. Sordes and sloughing epithelium are thoroughly removed.

One chemist of experience to whom these studies were submitted remarked that while, in experiment 5, there was much liberation of oxygen, it was, probably, not in the nascent state. Nevertheless, its effect upon the tissues is beneficial. The word nascent is derived from the Latin *nascens*, meaning newly born. Chemically, this means recently liberated from a combination, which applies to the oxygen liberated in experiment 5. Whether oxygen is here nascent or not, the combining power of the element does not wholly depend on its nascent condition, as evidenced by the rusting of iron when exposed to air. In a general sense, ionized elements are more active in chemical combination than non-ionized ones. In our search for drugs of value in the treatment of pathologic conditions, then, we should consider such factors as ionization, degree of dissociation in saliva and mucous fluids, osmotic pressure and specificity of action, as in the case of specifics such as mercury and arsenic.

Thus, for example, when water is added to it, the properties of saliva as a solvent are altered, and the degree of dissociation, upon which the ionization of solutes partly depends, is affected. Heat also affects the ionization of atoms or groups of atoms in solution; which raises the question of mouth temperatures on oxygen-liberating and other drugs.

Our search for active oxygen, therefore, must be one for the ideal ultimate of physical, chemical and biologic conditions under which oxygen may act

upon pathogenic organisms tending to disrupt the physiologic and anatomic stability of normal tissues.

BIBLIOGRAPHY

1. Roscoe, H. E., and Schorlemmer, Carl: Treatise on Chemistry. New York: Macmillan Co., Vol. 2, p. 1191.
2. Burton-Opitz, Russell: Elementary Manual of Physiology. Philadelphia: W. B. Saunders Co., 1925, pp. 231-232.
3. Bliss, A. R., and Olive, A. H.: Physics and Chemistry for Nurses. Philadelphia: J. B. Lippincott Co., 1926, pp. 36-37.
4. Attfield, John: Chemistry, General Medical and Pharmaceutical, pp. 138-141.
5. Brownlee, R. B., et al.: Elementary Principles of Chemistry. New York: Allyn & Bacon, 1926, pp. 507-510.

FIXED BRIDGEWORK WITHOUT THE USE OF IMPRESSIONS, MODELS OR ARTICULATORS

By S. G. Nicholson, D.D.S., New York City

IT is generally agreed by the members of the dental profession that any work performed directly in the mouth, whether it be an inlay, a three-quarter crown, a full crown or any other type of partial or complete tooth restoration, is better than any similar work performed by the indirect method. In restorations made by the direct method, the individual prepared tooth is more accurately fitted, proximal contact points are restored, there is harmony with the adjoining and opposing teeth in form and as nearly as possible perfect occlusion is established without spot grinding.

With this premise in mind, I began several years ago to think: "Why can we not carry out the construction of a fixed bridge practically to completion in the mouth?" I began experimenting and, gradually improving my technic, I developed the method which I shall now describe.

Before I describe the new technic of constructing fixed bridges, a method which I have been using for about three years with most satisfactory results, I shall describe briefly the procedure followed by practically all skilled operators in our profession at the present time, so that the reader may see the difference and thereby judge as to the advantages.

In fifteen years of practice, during which I rarely failed to attend a worth while table clinic, registered clinic, lecture and demonstration, or postgraduate course on the subject, I have always found that each operator, after finishing the abutment castings, places his faith for accuracy of results on the impressions, the models and the articulators; indifferent all the while to the indisputable fact that the only perfect models of any mouth are the jaws of the individual for whom the work is being done, and the only correct articulation for those jaws is that determined by the individual's temporomandibular joint, with the various excursions of the mandible.

Dr. Grubb,[1] of Cleveland, describes the use of articulators as follows:

> It is understood that articulators do not necessarily reproduce the natural movements of the mandible. . . . A discouraging feature of a general occlusal reconstruction is the difficulty of having the final results match the experimental or projected results as worked out on the machine. The finished restoration, in other words, does not assure such function in the patient's mouth as was

1. Grubb, H. D.: Occlusal Reconstruction. J.A.D.A., 25:372, March 1938.

obtained on the articulator. Many of us have found this out to our sorrow.

In spite of the truth of this statement, to which we all subscribe, most operators that I know continue to be guided by the articulator in all dental prostheses at the present time.

The usual method of procedure is as follows: After the preparation of the abutment teeth, the wax patterns are carved in the mouth, invested, cast, finished and fitted in their respective positions on the teeth. (Some operators carry out even the construction of the abutment castings by the indirect method.)

Then, even for a one-tooth restoration, full modeling compound impressions of both upper and lower jaws, with bite, are taken; the casting pieces removed

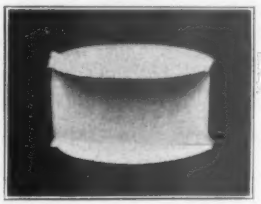


Fig. 1.—Bite tray which also serves as impression tray at same time.

from the teeth and placed in the impression, and casts poured and mounted on the articulator.

The pontic or pontics are then constructed and soldered to the abutments. They are then placed in the mouth, and it is invariably found that a great deal of grinding has to be done on the pontic castings, which weakens them, or on the opposing teeth, causing some damage in that direction; or both.

Then an occlusal register is taken in modeling compound and the parts are invested and soldered. The bridge is then finished and, in placing it in the mouth, it is found that there is more spot grinding to be done in order to establish a normal occlusion.

APPARENT REASONS FOR CLINGING TO THESE METHODS

This method of procedure in fixed bridgework is the result of a long standing habit, to which the profession still clings tenaciously; i.e., after a certain point, the work is passed over to some one else, either to a commercial laboratory or a technician in the office, or to the office laboratory, in which there is no technician employed, the operator himself assuming the rôle of the technician and, subconsciously, acting under the impression that he is a laboratory man.

Many men in our ranks who have in the past assumed the rôle of being their own technicians have felt that when

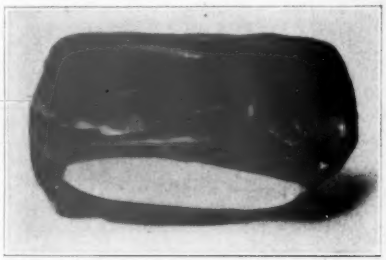


Fig. 2.—Pink paraffin and beeswax bite, which also serves as impression of both upper and lower jaw.

working in the laboratory they were no longer scholarly scientists. When they prepared the pontic teeth for a particular bridge, they developed so much of an inferiority complex that gradually they have decided to disregard their duty to the patient and to the profession and relegate their work to the commercial laboratory.

This grave mistake, detrimental not alone to that member but also to the entire profession, is the result of this time-long habit of separating, in our minds, the operative work and the prosthetic work into two distinct fields, the first to be covered by the doctor and the other (the inferior one?) by the technician.

What a fallacy! I cannot see the difference between preparing a, let us say, three-quarter crown on a vital tooth in the mouth, or doing the same thing on a porcelain tube tooth to be used as a pontic. The one requires the same accuracy of execution as the other. Or what is the difference between waxing a three-quarter crown in the mouth and waxing a three-quarter crown to a porcelain pontic tooth? All that remains to complete the bridge is the soldering, and for any dentist to do this is no disgrace. There is no polishing worth mentioning to be done because each of the units was polished with great ease before the bridge was assembled.

Fig. 3.—Impression bite after mandibular side has been poured.

The purpose of all this discourse is to prove that scientific dentistry cannot be divided into two separate phases, each to be practiced by one individual, independently of the other, as it is still thought of and practiced by a great many men at the present time. Operative work and prosthesis, especially in fixed bridges, are one entity, inseparable and indivisible. I am stressing this point because, very important as it is, it can also be rendered pleasant and easy to carry out by the method which I now describe.

THE NEW METHOD

I shall not describe the cavity preparation or the type of abutment preparations to be used in order to assure such results as comfort, good appearance, durability, sanitary factors and, above all, the biologic function of the teeth involved. It is neither necessary nor possible to do so here. These basic factors can be studied in any textbook. "Cavity Preparation and Abutment Construction in Bridgework" by J. R. Schwartz is one of the best.

After the preparation of the abutment teeth and the waxing, casting and finishing of the abutment pieces, I temporarily cement the castings in their respective teeth with a paste made of zinc oxide and eugenol and discharge the patient, to give the zinc oxide paste time to set.

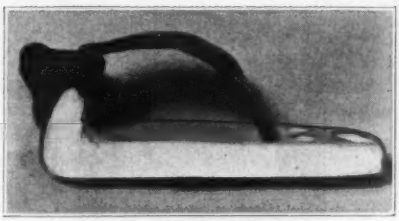


Fig. 4.—Model, with long tail arched over sheet of wax to permit clear view of lingual side of finished models.

SIMPLE IMPRESSION-BITE TAKING

At the next sitting, I merely register the relationship of the upper to the lower teeth in an impression-bite, in the following manner. I use pink paraffin and beeswax, and after softening the wax over the flame, I place it in a bite-tray made of two oval pieces of cardboard sewed together with a piece of muslin. (Fig. 1.) I place two-thirds of the wax on the side where the restoration is to be made and one-third on the opposite side. Both surfaces are warmed thoroughly and the wax is placed on the span over which the bridge is to be constructed and pressed slightly. I make sure that the patient closes in centric occlusion, instructing him beforehand. I cool the

wax thoroughly with cold air, place my index finger on it in the vestibule of the mouth and, pressing slightly, ask the patient to open his mouth, thus leaving the wax bite on the jaw in which the bridge is to be constructed. I then allow a few more blasts of air to cool the occlusal surface and carefully remove the wax bite. (Fig. 2.) I then take the shade and discharge the patient, leaving the abutment castings in their position in the mouth. These are more comfortable than temporary stoppings.

Fig. 5.—Facial view of finished, articulated models.

SMALL MODEL CONSTRUCTION

It will be evident from the steps which I give below in assembling the bridge that all I need to have in these models are the mesiodistal and occlusogingival dimensions of the missing one or more teeth, with a fair reproduction of the adjoining teeth, which I obtain more accurately than is actually necessary, by this method.

I now pour the mandibular side of the bite in plaster, allowing an extension of about 3 inches on the lingual side of the impression bite. When this is set, I trim it around and then take a spoon-shaped vulcanite scraper and scrape three depressions at the tail end of the cast in the shape of a triangle. (Fig. 3.) I attach a sheet of wax arched from the top of the lingual periphery of the impression bite to the base of the cast, in order to obtain a clear view of the lingual surfaces of the teeth in the casts. (Fig. 4.) I now apply separating medium to the plaster surface and pour the upper cast in articulation. I separate the models and am now ready for the construction of the pontic. (Figs. 5 and 6.)

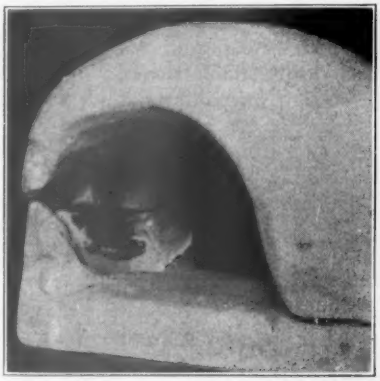


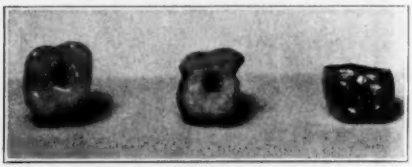
Fig. 6.—Lingual view of finished, articulated models.

PONTIC CONSTRUCTION

In constructing the pontic, I usually employ a tube tooth, the gingival end of which I close by baking on a small quantity of porcelain at 1900°. (Fig. 7, A.) First, with a lead pencil, I blacken the surface of the ridge portion of the span on the model. I select the shade and approximate size and mold of tooth that is needed and, holding it in position between the thumb and index finger, I rub it slightly against the blackened surface of the cast and grind the gingival end of it until there is proper alinement buccolingually and occlusogingivally. In grinding in posterior teeth, I always en-

deavor to have a round, highly glazed gingival end of the tooth barely touching the gum, with ample space mesially and distally, for hygienic reasons. In the case of anterior teeth, the pontics are, of course, ground in with a ridge lap for esthetic reasons.

In the next step, I grind the occlusal surface of the pontic tooth to allow for sufficient thickness of gold. To insure against breakage when tube teeth are used, I grind a groove extending from about the middle of the tooth on the mesial surface just lingually to the buccal surface, up to the occlusal, across the occlusal to the distal surface and down the distal surface to about the middle of the tooth, using a carborundum disk. Then, with suitable stones, I round off the mesial, lingual and distal surfaces



A B C

Fig. 7.—A, suitable tube tooth after it was trimmed to fit span occlusogingivally, mesiodistally and faciolingually and gingival end of tube portion closed by baking porcelain (1900°). B, tube tooth ground into actual three-quarter crown preparation of vital tooth. C, casting for pontic.

from the occlusal surface to about half or two-thirds of the way down the tooth (Fig. 7, B), thus establishing a box-like structure in the finished casting. (Fig. 7, C.) With this method, it becomes impossible to break or dislodge the porcelain from its gold casting during mastication. This preparation differs very little from the three-quarter crown preparation of a vital tooth in the mouth.

WAXING THE PONTIC

We are now ready to wax the pontic tooth for the casting which is to restore its anatomic form. In using a tube tooth, I first cut a strip of 40-gage copper plate about two-thirds the occlusogingival dimension of the prepared pontic in width, and about 2 inches in length; fit it loosely around the tooth, and clamp it with a hemostat. With a small brush, I now apply glycerine to lubricate the tube portion of the tooth, and the region around the area to be waxed, and also lubricate the prepared copper strip band. Then I press into the tube portion of the tooth pink sprue wax, of approximately the same gage as the opening in the tooth, cutting it even at the occlusal surface. Next I soften blue inlay wax and

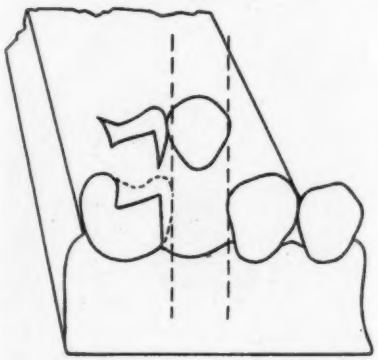


Fig. 8.—Manner of obtaining approximate relationship of pontic to abutment teeth before placing in mouth to get exact relationship.

press it into the prepared copper strip band, warm it over the Bunsen flame and press it in position over the tooth. I heat the end of an old explorer and dip it into the tube portion of the tooth on the occlusal surface, thus uniting the tube part with the rest of the wax. Then I chill, remove the copper strip and carve the tooth to its anatomic form, in conformity with the adjoining teeth on the articulated casts. After spruing, investing and casting, I polish it on an emery rubber wheel, following with pumice and rouge.

WAXING PONTIC TO ABUTMENT

At the next visit, I remove the one abutment casting and clean it, as well as the abutment tooth, thoroughly. I roughen with a stone the pontic and abutment castings at the points to be soldered so that the wax will adhere securely to the gold. With a hot spatula, I apply a small bead of sticky wax at each roughened point and, by holding the abutment casting and pontic tooth with the casting on it together over the span on the model which I used to construct the pontic (Fig. 8), I obtain the approximate occlusogingival and facio-

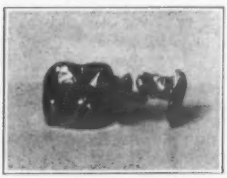


Fig. 9.—Pontic waxed to abutment in exact relationship to be invested for soldering.

Fig. 10.—Inside view of Figure 9.

lingual direction of the pontic in relation to the abutment teeth. Holding them in that relationship, I apply a drop of hot pink sprue wax at the joint. When it is cool, but still pliable, I place it in position on the abutment tooth in the mouth, have the patient close in centric occlusion and, with a suitable instrument, press the pontic tooth in alinement with the adjoining teeth and in proper occlusion with the opposing teeth. It is better to aline two or more pontics on the articulated casts, wax them together, invest and solder them and then place them in the mouth as if all one unit.

REMOVING THE WAXED BRIDGE FROM THE MOUTH

In removing the partially assembled bridge from the mouth, in order to solder the first abutment, one has to be careful not to break the wax joint. This is done in the following manner: When there is a large abutment casting and a small pontic, removal can be accomplished without much difficulty by carefully tapping out the abutment casting from its position on the tooth, thus getting the pontic out with it. (Figs. 9 and 10.) If the abutment casting is tight and the pontic large, it is safer to wax the occlusal surface in the mouth with sticky wax, protecting the patient with a paper or linen napkin placed over the lips and tongue. A loop made of an ordinary paper clip is warmed and pressed lightly over the sticky wax, and the wax is

Fig. 11.—Safe way of retaining exact relationship of pontic to abutment castings while removing from mouth, by inserting paper clip loop into sticky wax before doing so.

chilled. More sticky wax is added, then chilled again thoroughly and removed. (Fig. 11.) Even if the sticky wax breaks, the fracture is so clean that the units can be safely put together again before investing to solder, without destroying the proper relationship.

I often construct a bridge consisting of more than two pontics, in order to avoid partial plate construction. Irving R. Hardy, of New York, says: "A partial denture which entirely meets the requirements of functional occlusion or is otherwise ideal in every respect is, to my knowledge, seldom or never seen." I fully agree with him. As indicated above, I solder all the pontics together

according to the alinement on the casts, then place them in the mouth as in the case with one unit and, keeping the patient's teeth closed, with a warm spatula I fill both interproximal spaces between pontic and abutment teeth with softened pink sprue wax. Then, with a bridge tray, the buccal flange of which has been cut down to about one-eighth inch, I take a plaster impression of the linguomorsal surfaces, remove all units from the mouth, place in the impression, invest and solder the one abutment to the united pontics. I then go back to the mouth and repeat the process for soldering the other abutment.

In cases of long spans, if more than two pontics are being restored, and the use of more than two abutments as anchorage is necessary, all the abutments adjoining each other are soldered together with 22-carat solder before the impression bite for the construction of the pontics is taken.

Assembling a bridge in the mouth is not an easy procedure, but neither is it easy to prepare a wax pattern in the mouth or remove an impacted third molar. Any technic is difficult until it is mastered, as it can be, by practice and perseverance.

CONCLUSION

The method of assembling bridgework directly in the mouth here described has the following advantages:

1. The taking of full mouth impressions, the unpleasant operation to the patient, is avoided.

2. It is unnecessary to box and pour impressions.

3. That most deceptive instrument called an articulator is left out of the picture.

4. The abutment castings, once in their position on the abutment teeth in the mouth, are not removed except for a few minutes until the soldering is done, and thus it is unnecessary for the patient to wear, as he otherwise must at times for several days, uncomfortable temporary protectives on abutment teeth.

5. All discrepancies which are apt to develop owing to expansion and contraction of materials are obviated.

6. Adjustments in fitting the bridge in the mouth are completely eliminated.

7. The restoration is left intact with strength where needed, and there is no necessity for weakening the gold skeleton of the structure or the protection for the porcelain part of the bridge.

8. The opposing natural teeth of the patient do not have to be ground down to accommodate themselves to the new bridge.

9. The patients are well pleased because the bridge is comfortable the moment it is put in the mouth.

10. The entire procedure is carried out by the operator as if it were all operative work, thus eliminating from our minds the laboratory bugaboo, and, at the same time, keeping the dentist busy in the office during these depression days.

142 West Seventy-First Street.

PAST PRESIDENT'S ADDRESS

By SHEPPARD W. FOSTER, D.D.S., F.A.C.D., Atlanta, Ga.

IT has been the custom for a number of years at the annual meeting of the Past Presidents' Club of the American Dental Association to have an address by the ranking senior Past President. If my understanding is correct, such an address is intended to deal largely with the things accomplished during the régime of the Past President who is to do the speaking. As to things *not* accomplished, we shall simply skip that. Perhaps I had better fortify myself further by saying that this year is not really my turn to speak. It has devolved upon me because of the untimely death of the late beloved C. N. Johnson, who was scheduled to address you at this time.

Seriously, I can think of no more appropriate way of accounting for my stewardship than by first mentioning the fact that that great, good man whom we all knew affectionately as "C. N." was, upon my nomination, elected Editor of THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION. At the time I came into office, the affairs of THE JOURNAL were in a very chaotic state. It seems incredible that at that time such an important publication should be without an official editor, but such was the case. In Louisville, the year of my inauguration, I nominated Dr. Johnson as the official Editor and he was duly elected. During my term of office, the American Dental Association made a three-year contract with Dr. Johnson as Editor. This was the first step in setting up an official editorship of THE JOURNAL. We are all aware of the great service that Dr. Johnson rendered in this capacity and of the added prestige which he lent to the pages of THE JOURNAL. He put it on a nationally recognized basis, and I feel that I may be pardoned the display of a little pride in recalling that my nomination of Dr. Johnson resulted in a new era in the affairs of this great organ of the dental profession.

While speaking of Dr. Johnson here, we are reminded of other Past Presidents who have gone to their reward since I came into office. Let us pause here in reverence to them and to the work they accomplished for our profession. They are gone from us, but we feel, somehow, that they are present with us in spirit on this occasion. Let us not forget these men who have labored to make the American Dental Association what it is today. They have been rapidly passing from us. As I recall, the following have died since I was elected President in 1925: E. T. Darby, who served during 1883-1884; J. D. Patterson, 1892-1894; L. G. Noel, 1902-1903; Waldo E. Boardman, 1904-1905; M. F. Finley, 1905-1906; A. R. Melendy, 1911-1912; F. O. Hetrick, 1912-1913; Thomas P. Hinman, 1915-1916; LaFayette L. Barber, 1916-1917; William A. Giffen, 1923-1924; C. N. Johnson, 1924-1925; Robert T. Oliver, 1930-1931, and Martin Dewey, 1931-1932.

Perhaps it will be of interest also to recall that, during my administration, a budget and accounting system which had been adopted became a reality, resulting

Read before the Past Presidents' Club of the American Dental Association, St. Louis, Mo., October 25, 1938.

in a more simplified and efficacious method of handling the income and disbursements of the Association. The budget system, adopted on the resolution of Harvey J. Burkhart, at the Dallas meeting, contemplated, among other things, that all receipts from every source go to the treasurer; that all departments present their budgets, for which appropriations are made by the House of Delegates, and that all payments be made by vouchers prepared by the General Secretary and countersigned by some member of the committee or commission in charge of the particular department for which payment is made.

Another important development took place during my term of office, one in which I was deeply interested, but for which I assume little credit, the passing of Bill H. R. 7181, the "Equalization Bill." After being passed by both Houses of Congress, this was signed by the President of the United States, June 10, 1926. It provides that the dental officers of the U. S. Navy shall have the same opportunities for promotion as other officers in the Navy. This, from a dental standpoint, is one of the most important pieces of legislation enacted for the benefit of the dental profession. It has resulted in attracting a higher type of professional man to the Dental Corps of the Navy. To W. L. Darnell and his coworkers credit should be given for the passage of this legislation. I am glad that it occurred during my term.

Soon after I became President, I discovered that whenever I wanted to look up any subject in our Constitution and Administrative By-Laws, it was necessary to scan practically the entire contents. I was impressed with the great need of an adequate index to that work. Martin Dewey kindly accepted the appointment to correct this deficiency, and the Index which we have today is fundamentally the same as that worked out by him.

You perhaps will recall that while I was President, the Seventh International Dental Congress was held in Philadelphia, concurrently with the meeting of the A. D. A. During my term of office, Drs. Barber and Brown and I had a conference with Mr. Burgess, director of the National Bureau of Standards, and later with the then Secretary of Commerce, Herbert Hoover, in which we presented our arguments for establishing a cooperative research program at the Bureau of Standards. This was later worked out, and has proved to be of great value. Another act of mine which I hope justifies mention was the appointment of a special committee, consisting of Drs. Kelsey, Huff, Finley, Barber, and Brown, as chairman, which effected a cooperative arrangement with the laboratory of the American Medical Association for the assignment of a chemist to the American Dental Association to assist in a cooperative program for the standardization of dental proprietary preparations, as relating to materials and misleading claims.

I fear the consequences should I fail to mention also that during my régime Mrs. Foster was asked by the American Dental Association to act as hostess to the visiting ladies at a large luncheon at which the wives of the foreign representatives of the Seventh International Dental Congress were present. Mrs. Foster wishes me to state that this was not simply a "ladies' auxiliary" affair, but that the luncheon was given by the American Dental Association.

It is an inspiring thing to meet again with this organization, and it will ever be a source of joy to me to remember that, as a Past President, I have had the privilege of playing some small part in the development of our beloved Association.

106 Forrest Avenue, N. E.

THE JOURNAL *of the*
AMERICAN DENTAL ASSOCIATION

L. PIERCE ANTHONY, D.D.S., Editor

Published by the American Dental Association
212 East Superior St., Chicago, Ill.

All expressions of opinions and all statements of supposed facts are published on the authority of the writer over whose signature they appear, and are not to be regarded as expressing the views of the American Dental Association, unless such statements or opinions have been adopted by the Association.

Communications intended for publication in the scientific or literary pages of THE JOURNAL should be addressed to the Editor. All advertising or business matter should be sent to the Business Manager.

Subscription is included in the annual membership dues. The subscription rate to non-members is $5.00 a year in advance, this rate applying to both domestic and foreign subscriptions. All foreign subscriptions are to be paid in United States money.

APRIL *Editorial Department* 1939

THE AMERICAN DENTAL FOUNDATION

ON July 11, 1938, there was incorporated under the laws of the State of Illinois, The American Dental Foundation, a corporation oranized by the American Dental Association for the purpose of receiving donations and bequests, the income from which may be used in developing and promoting research, for relief purposes or in any other way designated by the donor.

The objects of the Foundation are: "(1) The advancement of the dental arts and sciences in all their branches. (2) To carry on or assist investigations; to issue publications; to conduct lectures; to extend financial aid or assistance to and cooperate with corporations, associations, institutions, societies, agencies or individuals as are now engaged in furthering the purposes above named, and to establish, promote, maintain and endow any such corporations, associations, institutions, societies or agencies, and, further, to use any and all lawful means for the advancement of the dental arts and sciences in all their branches which the corporation may deem expedient."

While the establishment of such an institution has been discussed

from time to time for several years by various members of the profession, the origination of a definite plan of procedure with a definite objective was conceived some years ago by Dr. Edward H. Bruening, then a Trustee of the American Dental Association.

The directors of the corporation are the Board of Trustees of the American Dental Association for 1938. In addition thereto, C. N. Johnson was made president; E. H. Bruening is secretary and Charles E. Rudolph and George B. Winter are members.

The impelling motive which gave substance to this thought was a realization of the desirability and practical necessity of devising and promoting means by which research designed to concentrate upon dental problems should be under the direct supervision and direction of the profession; the realization of the fact that even though dentistry and its problems relate specifically to the general human system and its diseases and are an inherent part of medicine, its problems would have to be dealt with on a separate and individual basis, as it were, and that while millions are devoted to general medical research, only a small part can be diverted to the study of what may be considered a fundamental factor in the health of the body as a whole.

From the very beginning of the propaganda for mouth hygiene, we have endeavored to interest the medical profession and the philanthropic-minded in the mounting evidence pointing unerringly to the fact that oral disease is related to and one of the most prolific sources of systemic diseases of numerous kinds, but it seems that in this instance the medical profession has been content to follow an age-old custom, and one for which it has frequently been criticized; namely, that of dealing with symptoms rather than causes.

In the meantime, within our own ranks and within our own resources, much attention has been devoted to broadening the service of dentistry—efforts by men imbued with unselfish devotion to highest professional ideals, working to make the service of the dentist more useful to the people, realizing that the health of the public is as much the concern of the dentist as it is of the physician. But there has also developed coincidently with these efforts the further and more fateful realization of the fact that our mouth health problems involve other and broader health aspects than merely those of the mouth; that, in order to solve our problems, help must come from varied sources; that practically all aspects of biology were tied up with the dental phase and that, inevitably, we cannot solve our problems alone.

Dr. Bruening and his confrères have therefore undertaken to establish a foundation which will concentrate efforts on our problems and at the same time endeavor to enlist the sympathetic interests of the lay public, furnishing also a dependable agency through which these interests can be intelligently served.

There have been philanthropic benefactions for dental health service, and some associated benefactions in common with medicine, but when the comparison is made of the extent of these benefactions with the extent to which mouth health is involved in general disease, the comparison is invidious, to say the least. And these dental philanthropies in the past have been devoted in the main to demonstrating through incontrovertible evidence the contention that proper care of the teeth and oral cavity is the best safeguard against bodily disease and is therefore among the most important of public health measures. This we have amply proved. We have also demonstrated the fact that dental care during childhood constitutes an investment that cannot be equaled at any later period. This one fact in itself justifies quite fully the claims of dentistry to serious attention as an important department of the science and art of healing.

The separation of dentistry from medicine, beneficial as it has been in developing an educational system that is unsurpassed in any specialty of medicine, has probably more than any other single cause impeded research in our particular field. Dentistry has been left to its own resources and, unfortunately, these have not been developed to the greatest advantage. The conflict of interest with the medical profession has checked dentistry in its efforts toward the health and welfare of the people.

The establishment of the Foundation, then, has for its first purpose an appeal to the dental profession to pool its available philanthropic resources for the study and solution of its many problems. While dentistry has never been blessed with many philanthropists or those able to make philanthropic gifts, we believe that if such funds as are available can be consolidated and intelligently dispensed, as is the purpose of the Foundation, much headway can be made toward solving our main problems, as well as toward attaining the second main purpose of the foundation—the encouraging and acquiring of ample contributions from lay sources to accomplish much research in dentistry.

Oral hygiene and mouth health applied in the public schools have made it evident that reasons other than prevention and relief of suffering

justify the claims of dental service for consideration as a public welfare measure.

Relief of dental disorders eliminates a factor of physical disability that constitutes a positive interference with physical and mental efficiency. Dental and oral hygiene work in the public schools has demonstrated the improvement which practical oral hygiene produces in the mental and physical efficiency of the pupils, and the relief of many cases of actual retardation due to dental defects among school children has furnished conclusive evidence of the dental origin of the retardation.

It is today well recognized that humanitarian considerations alone amply justify the encouragement, if not the practical enforcement of oral hygiene measures among children of school age, but in consideration of the fact that by far the greater number of them are educated at the expense of the taxpayer, and that retardation by reason of mental or physical disability entails an augmented tax for educational purposes, the economic factor becomes an added and cogent reason for effective oral hygiene work among public school children.

The Foundation earnestly solicits gifts and bequests, not only from dentists, but also from the laity, and promises faithful administration thereof in accord with the wishes of the donor and to the best interests and welfare of dentistry and the public.

All departmental activities of the Association will be represented in the board of directors of the Foundation and funds may be directed for the use of any special activity.

Membership on the board will not be limited to dentists, but every member, lay or otherwise, must be approved by the Board of Trustees of the American Dental Association.

The plan of the organization is in accord with the methods used by other foundations. It is designed to comply with the legal requirements of those who wish to make provisions in their wills for funds for specific purposes, to advance the cause of our profession and for the benefit of the public.

Herein is presented an opportunity to the philanthropically inclined to leave a heritage to dentistry that will help to put it on the high scientific plane to which we have long aspired, as well as establish an enduring memorial for the welfare of humanity.

OBITUARIES

OTTO JOHN SPECKER

(1880-1939)

Otto John Specker, D. D. S., son of Cosmus and Margaret (Allemang) Specker, was born February 11, 1880, at Elmira, Ontario, Canada, and died at his home in Reading, Pa., January 14, 1939.

He received his early education in the public schools of Elmira and the collegiate institute of Kitchener, Ontario. He graduated from the Dental School of the University of Pennsylvania in 1902 and immediately thereafter established himself in practice in Reading, Pa., where he continued to practice until the time of his death.

Always interested in the advancement of his profession, Dr. Specker took an energetic interest in his professional societies and was from the beginning an active member of his local, state and national societies and the Delta Sigma Fraternity. In 1909, he served his local society as president, and from 1912 until his death, he was secretary of the Reading Dental Society.

He was president of the Pennsylvania State Dental Society during 1924-1925 and corresponding secretary from 1916 to 1923. He always took an active interest in the management of the society both in council and on committees. He presented the original resolution which led to the House of Delegates plan in the Pennsylvania State Dental Society, and served the fourth district as trustee from the adoption of the plan until his untimely passing. During the World War, Dr. Specker had charge of the dental examination of drafted men for Berks, Lebanon and Schuylkill Counties.

One of the prominent practitioners of dentistry in Reading, he was actively interested in civic affairs. He was a member and officer of the Wyomissing School Board for many years; an officer of the Reading Musical Foundation; a member since 1918 of the Reading Choral Society and one of its officers for many years; a charter member of the local group of the International Association of Torch Clubs, and an active member of the Evangelical Lutheran Church of the Atonement in Wyomissing.

In the death of Dr. Specker, the profession of Reading, of Pennsylvania and of the United States have lost a loyal, true and constant protagonist. Unobtrusive, retiring in his manner, he had an unaltering interest in dentistry which gave him an aggressiveness in defending and promoting dentistry's interests somewhat contradictory to his natural inclinations. A loyal friend, but with seriousness of purpose and conviction that would even set friendship aside for what he considered higher aims, he would oppose even a friend in striving for the interests of his profession.

He never sought the limelight of office and leadership, but frequently accepted such positions purely as a means of promoting his constant interest in and desire for the good of dentistry.

The sterling qualities of his character were delightfully reflected in his friendships and particularly in a family life that was ideal.

Dr. Specker is survived by his wife, Delphine (Froelich) Specker; one son, John Carl Specker, D. D. S.; three sisters, Mrs. William A. Snyder, of Brooklyn, Mrs. Louis Andres and Mrs. Jacob Conrad, both of Waterloo, Ontario, Canada; and a granddaughter.

CLARENCE NILWEN NEWLIN
(1886-1939)

It is with a deep feeling of sorrow that the Illinois State Dental Society announces the death of its secretary, Clarence N. Newlin, which occurred at the Methodist Hospital, Peoria, Ill., Sunday morning, February 12, 1939.

As a member of the official family of the state society for the past two years, he endeared himself to all by his limitless enthusiasm, careful judgment and extreme loyalty.

He was born at Mt. Pulaski, Ill., June 7, 1886, the son of Willis and Sarah Braughton Newlin. When he was 10 years old, he moved with his parents to Gibson City, Ill., where he was educated in the public schools. He matriculated at the Chicago College of Dental Surgery, from which he was graduated in 1909.

Soon after graduation, he located in Morris, Ill., a few years later removing to Peoria.

On affiliation with the Peoria District Society, his activity and ability soon made him the valuable member he continued to be all through the years. He served on many committees as well as in the positions of secretary and president. Later, he served the Illinois State Dental Society as a member of various committees, as local arrangements chairman and as vice-president. At the time of his death, he was completing his second term as secretary.

Dr. Newlin always took a keen interest in the dental health education programs of the Peoria Public Schools and was instrumental in the organization of the Free Dental Dispensary for school children when economic conditions during 1933-1936 overburdened the dental department of the schools. He enjoyed civic duties as well as professional activities, being a member of the staff at the Methodist Hospital, president of the Citizens Building and Loan Association, a thirty-second degree Mason and a past president of the University Club.

July 19, 1912, he married Miss Grace Pearce of Gibson City, Ill.

He is survived by his wife, two children and his mother, Mrs. W. A. Newlin. Funeral services were held at the Methodist Church in Peoria, with interment in Springdale Cemetery.

DEATHS

Allen, George Willard, Rockville, Conn.; died March 4; aged 72.

Beck, Robert F., Webster City, Iowa; State University of Iowa, College of Dentistry, 1912; died December 2, 1938; aged 53.

Bell, William T., Chatsworth, Ill.; Chicago College of Dental Surgery, 1896; died November 29, 1938; aged 71.

Bender, J. Harry, Ashland, Pa.; University of Pennsylvania College of Dentistry, 1917; died July 14, 1938.

Bernard, Franklin P., Kennett Square, Pa.; Baltimore College of Dental Surgery, 1879; died February 6; aged 88.

Carl, Francis M., Freeport, Ill.; Chicago College of Dental Surgery, 1902; died December 25, 1938; aged 80.

Carman, Herman F., New York City; University of Buffalo, School of Dentistry, 1891; died December 18, 1938.

Concklin, Lewis Knapp, Chicago, Ill.; Northwestern University Dental School, 1907; died March 14; aged 61.

Davis, Freeman, Centerville, Iowa; Kansas City Dental College, 1897; died December 5, 1938; aged 67.

Dorman, Charles W., Strawberry Point, Iowa; State University of Iowa, College of Dentistry, 1890; died December 2, 1938; aged 73.

COUNCIL ON DENTAL THERAPEUTICS

The following article is presented as one in the Council's series on pharmacology and therapeutics. On behalf of the profession, the Council expresses appreciation to the author for his contribution.

ORAL BACTERIOLOGY: BASIC CONSIDERATIONS BEARING ON DISEASE AND THERAPY

By Basil G. Bibby, B.D.S., Ph.D., Rochester, N. Y.

Oral bacteriology has fallen into disrepute because it has contributed nothing to the prevention of dental disease. The use of vaccines and antiseptics is no longer regarded as effective against pyorrhea and dental caries. The failure of such methods has discouraged study in oral bacteriology, and advances in this field have not kept pace with those in other branches of the science. Today our understanding of the bacteriology of the mouth is so inadequate that it does not even provide a suitable foundation for sound hypotheses.

The realization that avirulent organisms may acquire pathogenic properties, and the significance which is now being attached to the natural defenses of the body and the functions of preexisting flora in determining the onset of disease, make studies of the normal flora important.[1] Furthermore, the demonstration that oral bacteria give rise to intermittent bacteriemia,[2] and the increasing importance of dental disease in general health, emphasize the need of more knowledge of the bacteriology of the mouth. The following summary of the present status of oral bacteriology is offered as a stimulus to studies in this field.

This report is made possible by a grant from the Carnegie Corporation of New York.

From the Division of Dental Research, School of Medicine and Dentistry, University of Rochester.

METHODS OF STUDY

Since the backwardness of oral bacteriology is largely due to the absence of suitable methods for study, it is important to consider some of the technical difficulties encountered. In the first place, estimates of the total numbers of bacteria in specimens from the mouth have little significance. If they are made by direct counts in hemocytometer or Breed smear, they include both living and dead organisms. If made by a plate-counting method, they reveal only from 1 to 20 per cent of the total number of organisms.[3] In either case, the findings mean little because they represent unknown mixtures of a variety of micro-organisms and do not take into account the variable proportions of saliva or débris in the samples. In the second place, the common cultural methods, mostly designed to be selective for pathogenic bacteria, are most unsatisfactory when applied to oral bacteria. The fact that the same inoculum will produce 90 per cent or more of streptococci, lactobacilli, fungi

or fusiform bacilli, according to the cultural procedure employed, demonstrates the false picture of flora which may be given by an uncritical choice of methods. Differential counts, in smears,[4] of the numbers of various morphologically distinct groups of micro-organisms have obvious disadvantages, but, in the absence of culture media, which will reveal in their correct proportions the various bacterial constituents of the oral flora, they provide information not attainable in any other way.

FACTORS DETERMINING THE ORAL FLORA

Because environmental conditions favor some bacterial species at the expense of others, the mouth does not support equally the growth of all micro-organisms. Thus, the basic flora of the mouth consist only of those micro-organisms for which the mouth is so well suited that they outgrow all other bacterial types.

The factors which determine what species of micro-organisms grow in the mouth or other places in the body have been little investigated. In the mouth, several mechanisms may operate:

1. The washing action of the salivary and mucous secretions[5] carries bacteria introduced into the mouth along definite paths to the pharynx. As a result, the organisms which persist in the mouth will be those which multiply rapidly therein, are attached to tooth surfaces or are located in cavities or gingival pockets where washing effects are at a minimum.

2. Saliva kills or inhibits the growth of many types of micro-organisms. This idea has long been entertained, but only recently a growing body of work has forced its acceptance. Our experiments[6] show that the growth of 65 per cent of 161 strains of micro-organisms of different types was prevented by the action of the saliva. The common contaminating organisms such as the sarcinae and bacilli were most susceptible to salivary action. Pathogenic parasites were less affected. Mouth bacteria such as fusiform bacilli, leptotrichia and the viridans streptococci were unaffected. The autosterilizing properties of certain areas of the oral mucosa[7] may be related to the action of one of the two salivary principles[8] which have been recognized.

3. The established flora may prevent the growth of extraneous bacterial types by the antagonistic effects of some of their constituent bacteria killing newcoming organisms (e.g., mouth streptococci kill meningococci[9]), or by the existing flora crowding out and preventing the colonization of outside organisms.[1]

These considerations indicate the importance of modifications in the mouth fluids or changes in the bacterial associations in providing the opportunity for pathogenic organisms to establish themselves in the mouth.

NATURALLY OCCURRING VARIATIONS IN THE ORAL FLORA

Variations in the nature of the oral flora have been noted between different areas in the same mouth,[10, 11] between different mouths,[3, 12, 13] from day to day,[13] and more permanently during the establishment of the flora of infants' mouths.[14] We[15] have confirmed the existence of such variations in differential smear counts. Wide differences were noted from one healthy or diseased mouth to another. Dissimilarities also appeared between different areas in the same mouth, the gingival margins having on the average 7 per cent more fusiform and filamentous organisms than the buccal mucosa. The flora of carious cavities were not distinctive. In the same location, changes were noted from time to time, but, in one mouth, given groups of organisms tended to maintain the same relative frequency of occurrence. Gram-positive cocci, for instance, would be repeatedly more numerous than gram-

negative cocci, or filamentous bacteria than bacillary or fusiform types.

Variations have also been noted in the numbers of bacteria from mouth to mouth, location to location[8] and at different times. The changes from time to time are great enough to invalidate experiments on the effects of dietary[16] or therapeutic[17] procedures.

ARTIFICIALLY PRODUCED VARIATIONS IN THE ORAL FLORA

The nature of the flora cannot be materially modified by artificial means. The adoption of a protein diet produces only slight increases in the numbers of spirochetes; and changing to a high carbohydrate diet, a like increase of lactobacilli.[16, 18] Efforts to establish various types of bacteria in the mouth by the implantation of cultures have failed.

Temporary changes in the numbers of bacteria can be brought about fairly easily. By brushing the teeth,[8] considerable reductions have been effected in the numbers in a unit amount of mouth débris. Mouth washing[17] reduces the total by from 10 to 15 per cent, but is followed by an increase above the original number. With a nonmedicated tooth paste,[17] the reduction is as much as 40 per cent and the original count is not exceeded for a longer period. Smoking[17] has a similar effect. Eating[16] lowers the number of bacteria, but detergent diets have no particular effectiveness. Normal variations prevent significance being attached to the changes brought about by antiseptics.[19] Attempts to sterilize the mucous membrane by vigorous brushing and the use of mucin solvents proved unsuccessful,[5] apparently because the basic flora of the mouth proliferate in the crypts and gland orifices where the antiseptics are ineffective. However, on dried mucous membranes, strong antiseptics will maintain sterility for periods of a minute or more.

NATURE OF THE ORAL FLORA

There is little agreement concerning the nature of the oral flora and the relative frequency of occurrence of constituent micro-organisms. This confusion is largely the result of placing too much reliance on inherently selective culture media and ignoring the existence of the bacterial types which, as yet, can be studied only in smears. The existence of incompletely studied pleomorphic bacterial types, and the absence of a satisfactory basis of classification or nomenclature, complicate attempts to describe the oral flora.

A great variety of organisms are known to exist in the mouth and practically all known types of bacteria have been isolated from it from time to time. However, the occasional finding of tetanus bacilli and the like in it merely indicates that they are transitory inhabitants and does not establish them as members of the oral flora. Such a position should be reserved for those organisms which are present in detectable numbers in all mouths and which undergo multiplication there. Unfortunately, we have no satisfactory way of identifying these types or of classifying them. Therefore, the most practical way of reviewing the flora is to consider in order the oral micro-organisms falling in the major bacterial groups (cocci, bacilli, etc.)

Cocci.—Cocci outnumber all other types of organisms. In more than 90 per cent of actual counts[15] of organisms from different sites in many mouths, they made up more than 50 per cent of the total. Gram-positive and gram-negative cocci are found in varying ratios. Estimates generally indicate an excess of gram-positive forms. Correlated smear and culture studies indicate that streptococci predominate.

No recent study of the oral streptococci has been made. General reviews[20] suggest that most of alpha and nonhemolytic mouth types should be grouped as

viridans streptococci. The predominating type, *S. salivarius,* is a slightly larger organism than the pyogenic streptococci, but does not subculture so satisfactorily. The other major groups of streptococci are not prominent in the mouth. Enterococci have seldom[21] been reported, but we found that *S. faecalis* or kindred types were not uncommon. Although sometimes found in inflammatory conditions, the group of pyogenic streptococci (hemolytic) are of rare occurrence.

Of the other gram-positive cocci found in the mouth, anaerobic forms seem to be the most common. Several types have been demonstrated, most of which are facultative aerobes. Of the completely obligate types, *Micrococcus buccalis*[22] is of interest because it forms gas during the fermentation of carbohydrates.

The frequency of occurrence of staphylococci and sarcinae has never been established. Although staphyloid colonies are seen, we have seldom found typical staphylococci except in inocula from about the exposed portions of the mouth. Sarcinae are slightly more common, but never numerous. The distribution of these organisms in the mouth is in keeping with the relatively active bactericidal effect which saliva exerts on them. On media with a high carbohydrate content, viscous colonies of bunched cocci sometimes appear. These organisms resemble *Leuconostoc* and are probably *Staphylococcus viscosus* of earlier writers.

Gram-negative cocci are common in the mouth and occasionally are more numerous than the gram-positive forms. In 20 per cent of actual counts,[15] they comprised more than 50 per cent of the total organisms. The few gram-negative cocci revealed in cultures indicate the existence of uncultivated species. Except for the meningococci and gonococci, there are no reliable criteria for identifying the cultivable types. Anaerobic gram-negative cocci are also found. The few strains studied fall into no satisfactory groups. One type *(Micrococcus gazogenes)*[16] is peculiar because it forms gas during the fermentation of carbohydrates. The uncertain staining reactions of some of these types suggests that they may have a close kinship with the gram-positive anaerobes.

Bacilli.—Except for early work which is of questionable value, few types of true bacilli, as distinct from the fusiform bacillus or leptotrichia, have been found in the mouth. Direct counts indicate that bacilli represent a higher percentage of the oral flora than cultures indicate. In more than half the smears examined,[15] there were 10 per cent or more of bacilli.

Of the cultivated types of gram-positive bacilli, *Lactobacillus acidophilus* has attracted most attention. Although an association exists between the numbers of lactobacilli in the mouth and dental caries,[18] a satisfactory definition of these organisms is still lacking. One type recognized as a lactobacillus by some workers is considered a streptococcus by others.[23] Because of the exclusive use of selective culture media, it is not generally realized that even in carious mouths, lactobacilli seldom constitute as much as 2 per cent of the viable organisms. No two descriptions of the diphtheroid and spore-forming bacilli, occasionally cultured from the mouth, are alike. It seems likely, therefore, that they are only transitory inhabitants of the mouth.

Our knowledge of the gram-negative bacilli is very fragmentary. Organisms of the colon-aerogenes group can seldom be cultivated and *Serratia* and *Pseudomonas* appear only as contaminants. *H. influenzae* has been isolated occasionally. The only regularly cultivable bacillus is an unidentified fine regular anaerobic rod.

Vibrios.—One or 2 per cent of the organisms in most mouths are vibrios, but in about one eighth, they make up 5 per cent or more of the total. From cultural studies, it has not been possible to recognize definite types, but these and mor-

phologic studies indicate the existence of large and small vibrios. The former have been given the name *Spirillum (vibrio?) sputigenum* and the latter *Vibrio viridans.* In dark field motion pictures, a large moderately motile vibrio with a single subterminal flagellum and a very small excessively motile type can be recognized. Increases in the occurrence of vibrios, especially the large type, are sometimes noted in gingivitis and pyorrhea, but such increases also occur in normal mouths.

Fusiform Bacilli.—Fusiform organisms make up more than 10 per cent of the flora in more than 80 per cent of the mouths examined.[8] Three main types of *Fusiformis* have been recognized[24] in the various morphologic and cultural studies, a large *(F. dentium),* a filamentous *(F. polymorphus)* and a small type *(F. nucleatus).* These types constituted more than 5 per cent of the organisms in respectively 47, 27 and 67 per cent of normal mouths.[8] *F. dentium* is the predominant organism in Vincent's infection and other inflammations of the mouth. Increases in *F. polymorphus* are also noted about unhealthy gingivae, and *F. nucleatus* is more numerous in pyorrhea. Differences between the various types of fusiform organisms are very marked. In cultural characters, some of the small types resemble vibrios or *Pfeifferella;* whereas the properties of the large types merge with those of the leptotrichia. The large types seem to be slightly less affected by oxidizing agents.[25] It is very apparent that the present genus *Fusiformis* embraces a varied group of organisms with only one common character—the possession of pointed ends.

Leptotrichia.—To distinguish them from the autotrophic filamentous organisms *(Leptothrix),* the name *Leptotrichia* is given to the characteristic filamentous bacteria of the mouth. Typically, the leptotrichia are long, thick filaments, frequently showing clubbed or swollen ends and granular staining. Because of their size, they are obvious in casual examinations of smears, but in only about a quarter of actual counts[15] make up more than 5 per cent of the total number of organisms.

Leptotrichia buccalis[15] is most commonly found in smears and anaerobic cultures. It is easily identified by its staining reactions, which are the same as those of the diphtheria bacilli. In having tough colonies which in liquid media adhere to the walls of a glass tube, it resembles the actinomyces. Other cultivated leptotrichia show more resemblance to the fusiformis organism and have no such uniformity of morphologic and cultural characters. Some filaments distinguished in smears, including a very large round-ended iodine-reacting filament, have not been cultivated. Characteristic matlike accumulations of leptotrichia occur in dental plaques and in association with calculus.

Actinomyces.—Because the presence of débris and angulated organisms gives the appearance of branching, branched organisms *(Actinomyces)* can very seldom be recognized with certainty in smears.[25] However, since some types *(Actinomyces bovis)* fragment readily, the apparent absence of branched elements does not indicate that actinomyces do not exist in the mouth. Cultural studies reveal the presence of from 1 to 3 per cent of tough, adherent, actinomyces-like colonies composed of clubbed and branched bacilli or short filaments. Resemblance to *Actinomyces bovis* is very close. These organisms have not been found to be associated with any particular condition of the mouth.

Spiral Organisms.—The association of the spiral organisms of the mouth *(Treponema)* with disease has attracted a good deal of attention.[26] Although the number of treponemata is vastly increased in certain inflammatory conditions, sometimes to the virtual exclusion of all other organisms, they are not numerous in normal mouths and seldom

make up 1 per cent of the flora.[15, 16] In spite of reports of their cultivation, a reliable cultural method is still lacking. Cursory study reveals the existence of morphologically distinct spirals, and on this basis various subdivisions of the oral treponemata have been suggested. Dark field motion pictures indicate that an almost infinite number of subdivisions could be made. However, until there appears some reason for making distinctions on minor morphologic attributes, the simplest classification is the best. We recognize three types: (1) *T. vincenti* (fine, long, with wide, irregular coils, and very flexible); (2) *T. microdentium* (and *T. macrodentium)* (fine, pointed, with even, close coils); (3) *T. buccale* (short, thick, with irregular, wide coils). *T. vincenti* is associated with Vincent's infection and inflammatory conditions of the mouth. What is possibly a distinct type of spiral organism *(Leptospira)* is sometimes seen. This has the typical hooked end and rapid spinning of the leptospira, but may only be a treponema with a more or less permanently kinked end.

Complex Mouth Organisms.—Organisms of bacterial dimensions, but with a complex structure resembling that of fungi, have been observed.[15] One type, which bears some likeness to the autotrophic *Leptothrix,* has been repeatedly described under the name *Leptothrix racemosa.* It consists of a central stalk on the end of which rows of coccal bodies are arranged. The other end of the stalk may be attached at a central point, or colony, from which other "stalks" radiate. The other complex types, *Leptothrix falciformis* and *Leptothrix gigantea,* seem to be too rare in occurrence and too diverse in structure to justify their being regarded as bacterial entities. Instead, we regard them as chance aggregations of bacterial elements or organisms introduced from outside the mouth.

Fungi.—Although cultures on favorable media occasionally show a few yeastlike organisms, these are always very scarce and seldom, if ever, total 1 per cent of the colonies. Smear studies confirm their rarity in the normal mouth. Probably, most of these organisms have been introduced with the food and survive in the mouth only in the presence of food remnants. Monilia are found in pathologic conditions such as thrush. In other rare conditions, mycelia-forming organisms are found representing a fairly large number of the local flora.

RELATION OF BACTERIA TO PATHOLOGIC ORAL CONDITIONS

Because of the complexity of the oral flora, numerous types of organisms are always associated with pathologic conditions in the mouth. Consequently, it is extremely difficult to establish the causal relationship of any particular microorganism. At the present state of our knowledge, it is not possible to ascribe a definite bacterial cause to any of the pathologic conditions encountered in the mouth. The most we can do is to point out bacterial associations which may in time be proved to be causes.

Plaques and Calculus.—The ability of leptotrichia and actinomyces colonies to adhere to smooth surfaces and the presence of matlike formations of filamentous organisms in plaques[26] (as distinct from nonmembranous films and food deposits) suggest that these organisms have a causative function. In calculus, these filaments form a stroma which may hold any calcium salts precipitated from the saliva. These organisms may also help to precipitate calcium salts either by producing a local alkaline conditions or destroying the colloidal protective power of the proteins.

Vincent's Infection.—Although the association of treponemata and fusiform organisms with Vincent's infection point to a causal relationship, it has not been

possible to establish this experimentally. The most suggestive experiments indicate that in addition to spirochetes and fusiform organisms, cocci and vibrios are necessary. A predominance of treponemata in early cases and in the deeper tissues from infected areas suggests that they are the aggressive agents.

Gingivitis.—While fusiform organisms and spirochetes are prominent in most inflamed gingivae, it is probable that they are the result rather than the cause of the inflammation. The occurrence of cocci or vibrios in almost pure culture in some types of gingivitis indicates that they may be the provoking agents. So far, the nature of cocci and vibrios has not been determined.

Pyorrhea.—Since pyorrhea pockets provide areas in which the normal antibacterial activities of the mouth are at a minimum and in which degenerating tissue provides a more than usually varied medium for growth, it is natural that a greater variety of organisms should be found there. Whether the resultant abnormal flora contain organisms capable of inducing tissue destruction is not known.

Dental Caries.—It has not yet been satisfactorily demonstrated whether the association between dental caries and lactobaccilli[18] in the mouth is a causal or resultant relationship. The fact that these organisms never represent more than a minor part of the flora makes it seem unlikely that they are the sole bacterial cause. Streptococci[27, 28] of various types have been shown to predominate in caries and to show almost the same parallelism with its activity as do the lactobacilli. However, more work is needed to establish either lactobacilli or streptococci as the only or the principal cause of caries. Possibly, caries is brought about by a number of different types of bacteria acting singly or in association. The bacterial agents in caries may differ from mouth to mouth or even from tooth to tooth.

RELATION OF MOUTH BACTERIA TO DISEASE IN OTHER PARTS OF THE BODY

Ignorance of the nature of the organisms in the mouth makes it difficult to identify them or to determine their significance in other parts of the body. The distinctive and early recognizable representatives of the oral flora, such as fusospirochetal organisms, can be shown to be concerned in lung abscess formation.[29, 30] Less distinctive organisms cannot be identified. For instance, evidence that the serious infections resulting from tooth wounds are brought about by the presence of an anaerobic mouth coccus rests upon a less secure basis. Similarly, it cannot be decided whether the actinomycotic infections of the jaw and lungs are caused by the actinomyces-like organisms of the mouth. It is most difficult of all to determine the significance of the oral bacteria in focal infections. It is more certain than ever that oral infections give rise to bacteriemia, but whether the presence of organisms thus distributed throughout the body gives rise to infections is not known. The answer to this question will largely determine the character of the future development of dentistry. However, the answer cannot be given until we know, first, more about the mechanism of focal infection itself, and, second, enough about the fundamental bacteriology of oral micro-organisms to be able to identify them no matter from what part of the body they may be recovered.

BIBLIOGRAPHY

1. Topley, W. W. C., and Wilson, G. S.: Principles of Bacteriology and Immunity. Ed. 2., Baltimore: William Wood and Co., 1936.

2. Okell, C. C., and Elliot, S. D.: *Lancet*, 2:869, October 19, 1935.

3. Kligler, I.: *J. Allied. D. Soc.*, 10:141, 282, 445, 1915.

4. Bibby, B. G.: *J. D. Res.*, 17:265, August 1938.

5. Bloomfield, A. L.: *Am. J. M. Sc.*, 164: 854, December 1922.

6. Bibby, B. G.; Clough, O. W., and Hine, M. K.: Antibacterial Action of Human Saliva. J.A.D.A., 25:1290, August 1938.

7. Stuart, C. W.; Knudson, W. N., and Arnold, L.: *J. D. Res.*, 15:41, February 1935.

8. Bibby, B. G., and Hine, M. K.: Unpublished data, 1938.

9. Gordon, M. H.: *Brit. M. J.*, 1:849, 1916.

10. Andre, H.: *Deutsche Zahnartzl. Wchnschr.*, 19:433, 1934.

11. Brailovsky-Lounkevitch, Z. A.: *Ann. Inst. Pasteur*, 29:379, 1915.

12. Pickerill, H. P., and Champtaloup, S.: *Brit. M. J.*, 2:1482, 1913.

13. Thomson, D., and Thomson, R.: *Pickett Thomson Ann.*, 9:58, 1932.

14. Witkowski, R.: *Zentralbl. f. Bakt.* (Abt. 1), 133:334, February 18, 1935.

15. Bibby, B. G.: Thesis, University of Rochester, 1935.

16. Howitt, Beatrice, and Fleming, W. C.: *J. D. Res.*, 10:33, February 1930.

17. Appleton, J. L. T.: Bacterial Infection. Ed. 2. Philadelphia: Lea & Febiger, 1935.

18. Bunting, R. W.: *Proc. IX Internat. D. Cong.*, 1936, p. 323.

19. Crowley, Mary C., and Rickert, U. G.: *J. D. Res.*, 16:531, December 1937.

20. Sherman, J. M.: *Bact. Rev.*, 1:1, 1937.

21. Kramer, S. D.: *J. Allied D. Soc.*, 13: 425, December 1918.

22. Ozaki, Y.: *Zentralbl. f. Bakt.* (Abt. 1), 76:118, 1915.

23. Anderson, T. G., and Rettger, L. F.: *J. D. Res.*, 16:489, December 1937.

24. Bergey, D. H.: Determinative Bacteriology. Ed. 4. Baltimore: Williams and Wilkins Co., 1934.

25. Knighton, H. T., and Bibby, B. G.: Unpublished data.

26. Bibby, B. G., and Van Huysen, Grant: Changes on Enamel Surface, a Possible Defense Against Dental Caries. J.A.D.A., 20: 828, May 1933.

27. Clarke, J. K.: *Brit. J. Exper. Path.*, 5:141, June 1924.

28. Belding, L. J.: Personal communication to the author.

29. Smith, D. T.: Fusospirochetal Disease. Baltimore: Williams and Wilkins Co., 1932.

30. Lueth, H. C., and Sutton, D. C.: *J. Lab. & Clin. Med.*, 21:1056, July 1936.

ACCEPTED DENTAL REMEDIES

The Council on Dental Therapeutics of the American Dental Association announces the inclusion of the following article in the list of Accepted Dental Remedies.

Dentifrices*

Berner's Tooth Paste: Composition: See Sheffield Tooth Paste (A.D.R. 1938, page 117).

Disfributed by The Sheffield Company, New London, Conn. Distributed by Dr. Berner's Pharmacy, Inc., New York City. No U. S. patent or trademark.

Admission of an article to the list of Accepted Dental Remedies does not imply a recommendation. Information on the rules and work of the Council will be sent on request.

Harold L. Hansen, *Secretary.*

*A.D.R. 1938, p. 112.

ASSOCIATION ACTIVITIES

COMMITTEE ON LEGISLATION

STATE DENTAL LEGISLATION, 1939

THE 1939 SESSIONS of the state legislatures are in full swing and apparently the majority of the new bills have been introduced. For this reason, the Committee on Legislation has believed it advisable to present a summary of some of the more important pieces of legislation which affect the practice of dentistry and which have already been introduced in the present sessions. At a later date, a complete summary of all of the laws that are enacted this year will be published.

The present summary can do little more than indicate the general types of legislation that have been proposed because most of the bills have not been voted on as yet and many are in the various stages of enactment. As far as possible, the status of the bill at the time the summary was prepared is indicated.

Bills Passed

ARKANSAS

House 92. This bill provides that nothing in the definition of the practice of dentistry shall prohibit a licensed physician from extracting any teeth in an emergency, when a dentist is not available; enacted March 1, 1939.

WYOMING

House 18. This bill requires the addition of a resident licensed dentist to the state board of health; enacted February 8, 1939.

Bills Introduced

ARIZONA

House 89. This amends the dental practice act to require all candidates for licensure to be citizens of the United States. It was amended by the House by adding "or who has declared his intention of becoming a citizen and has resided in Arizona for a period of not less than two years"; passed in the house, reported favorably in the senate.

House 103. This bill provides additional grounds for revocation of licenses to practice dentistry. Among these are: advertising professional superiority, prices, credit or terms; guaranteeing work and painless dentistry; passed in the house.

ARKANSAS

Senate 223. This levies a 2 per cent tax on all articles of tangible personal property sold by a dentist.

House 260. This proposes to permit organization of agricultural cooperatives authorized to arrange medical, dental and other health services for their members without compliance with insurance laws.

House 434. This provides that action for malpractice may be brought at any time within three years after the discovery of the cause of action. Previously, the period of three years dated from the time the injury occurred and not from the time of discovery; reported favorably in the house.

CALIFORNIA

Senate 551. This bill proposes a state compulsory health insurance system with three sources of funds: (1) wage deductions, (2) employers contributions and (3) state contributions. The percentage of wages contributed depends upon the weekly wage rate. The services of a dentist are to be provided "in such treatment and care, including restorative work, as may be found necessary to correct conditions which are seriously prejudicial to health or threatening to interfere with employment."

Senate 989. This provides for repeal of the dental practice act.

Senate 990. This creates the Dental Corporation of California for integration of the profession. All licensed dentists will become members of the Dental Corporation, which shall be a self-governing organization.

Senate 1128. This proposes a system of health insurance within the system of unemployment reserves, contributions to be made by workers, employers and the state, based upon the monthly wage rate. Dental surgery will be provided "to the extent the resources allow." State and district medical advisory councils will be appointed. Representatives of other professions, chosen by local groups, will also be members of local advisory councils.

Assembly 548. This proposes the regulation of health and hospital service plans. Dental services may be provided for subscribers. The commissioner of insurance must approve all rates and contracts.

Assembly 1766. This bill would amend the dental practice act to require all applicants for licenses to be citizens of the United States.

Assembly 1826. This bill requires every registered dentist to notify the dental board of every change in the place of practice, within one month of such a change. Dentists desiring to practice in more than one office must have the approval of the board.

Assembly 2189. This restricts the state board examination to subjects which are in the curricula of the state dental colleges. If any change is to be made, all dental schools in the United States must be notified two years before the change is made.

COLORADO

Senate 332. This requires every applicant for a license to practice any of the healing arts to be a citizen of the United States; passed in house and has gone to third reading in senate.

CONNECTICUT

Senate 54. This authorizes the dental commission to rent space in out of state dental schools for the purpose of conducting licensing examinations.

Senate 305. This bill creates a state department of licensing including all professions and vocations. It provides for one executive secretary, who shall be secretary of each of the boards and commissions.

Senate 399. This bill proposed a 2 per cent tax on gross incomes of all professions granted exclusive rights to practice in the state; killed in house.

House 1495. This provides that the governor shall appoint a commission consisting of five members, which shall study and investigate the subject of health insurance for the state.

DELAWARE

House 315. This bill amends the Dental Practice Act.

GEORGIA

House 406. This imposes a 1 per cent tax on the gross income of dentists in addition to license taxes, etc.; reported unfavorably by the committee.

ILLINOIS

Senate 52. This bill proposes that den-

tists, physicians and hospitals rendering service to persons injured by the negligence or wrong of another shall have a lien on all claims or causes of action accruing to such injured persons.

INDIANA

House 494. This requires every surgeon, physician, dentist and nurse to submit to tests for syphilis every twenty-four months.

IOWA

House 348. This permits dental hygienists to assist a licensed dentist in the practice of his profession; reported favorably by the Public Health Committee.

KANSAS

Senate 87. This bill proposes to increase the annual registration fee from $1 to $3; passed in the house, reported favorably in the senate.

House 375. This imposes a tax of 15 mills on the dollar on the gross receipts of all businesses and professions; reported unfavorably by committee.

MAINE

Senate 52. This amends the dental practice act to require that all applicants for licenses by citizens of the United States and domiciled in the state for six months; passed in both houses and referred to the governor.

House 1645. This creates a department of professional licensing with a chief who shall be the permanent secretary of all professional licensing boards. Each board will continue its duties as before.

MARYLAND

House 15, Senate 12. This bill proposes the creation of a state department of registration which will include all of the now existing licensing boards.

MASSACHUSETTS

House 1898. This proposes a system of compulsory health insurance for the state. Contributions are to be as follows:

Employers:

3½ per cent on wages less than $20 weekly.

2½ per cent on wages from $20 to $40 weekly.

1½ per cent on wages more than $40 weekly.

Employes:

1 per cent on wages less than $20 weekly.

2 per cent on wages from $20 to $40 weekly.

3 per cent on wages more than $40 weekly.

There is provision for medical advisory councils (with dental representatives) in state, district and local organizations.

MICHIGAN

House 47. This amends the dental practice act to include additional types of advertising which are prohibited. These additional clauses are also added to the section defining acts which constitute justification for revocation of licenses.

House 199. This bill proposes a complete revision of the dental practice act with particular reference to the sections dealing with the definition of what constitutes the practice of dentistry, the prohibition of certain types of advertising and the grounds for revocation of dental licenses.

MISSOURI

Senate. 29. This bill proposes a basic science examination which all applicants for licenses in the healing arts must pass before being eligible for the licensing examination.

House 579. This revises the law concerning dental examiners.

NEBRASKA

183. This increases the dental license fee from $25 to $50 and license through

reciprocity, without examination, from $50 to $75; the second reading in the house.

NEVADA

Assembly 159. This bill proposes the addition of a doctor of dental surgery to the state board of health.

NEW HAMPSHIRE

House 33. This bill proposes amendments to the dental practice act dealing with the method of appointing members of the state dental board. It also includes a provision requiring all applicants for licenses to be citizens of the United States; amended and passed in the house.

NEW YORK

Senate 180, Assembly 260. This bill provides that any one practicing a profession without a license may be restrained from doing so by a permanent injunction issued by a court at the request of the attorney general.

Assembly 20. This provides for the employment of a dentist in each school district of the state for the purpose of making inspections of the school children's teeth. Two or more districts may collaborate in hiring one inspector.

Assembly 523. This bill establishes a state-wide plan of public medicine creating four new divisions in the health department. These new divisions are medical, dental, nursing care and pharmacy. The bill increases the salary of the commissioner and provides for three deputies.

Assembly 614. This proposes the establishment of a temporary commission to make a thorough study of dental needs throughout the state. The commission is to consist of seven members, four of which shall be recommended by the state dental society.

Assembly 801. This bill amends the dental practice act to require that all applicants for dental licenses must be citizens of the United States; amended in the house.

NEW MEXICO

House 43. This amends the dental law to include a provision requiring all applicants for dental licenses to be citizens of the United States and graduates of dental schools situated in this country as classified by the Council on Dental Education of the American Dental Association; passed in the senate and amended in the house.

NORTH CAROLINA

Senate 88. This provides a uniform procedure for the revocation of all professional licenses. The various boards must all comply with this procedure.

OREGON

Senate 325. This amends the dental practice act in relation to requirements for licenses. It requires that all applicants must be United States citizens. After 1941, all applicants must have had two years of college and four years in dental school; passed in house.

Senate 341. This bill redefines the powers and duties of the state board of dental examiners; passed in the senate and the house and sent to the executive.

SOUTH DAKOTA

Senate 25. This provides that all persons rendering personal services shall have a lien on all property of the person receiving such services, either for the contract price or for the reasonable value of the services.

WASHINGTON

Senate 264. This bill restates the advertising prohibitions, but includes a new exception; namely, a person may announce credit, terms of credit or installment payments, but may not advertise any specific amount of credit, terms of credit or installment payments; reported favorably in the house.

WISCONSIN

Assembly 366. This bill prohibits the use of any office sign of greater area than 600 square inches. Such sign may contain only the name, titles, office hours and other matter not in conflict with law.

In Congress:
National Health Act of 1939

S. 1620 introduced in Congress by Senator Robert F. Wagner, New York, February 28, carries several amendments to the Social Security Act and would provide federal funds amounting to $80,000,000, with increases over a period of ten years, to establish and improve state health programs for promoting the health of mothers and children and providing care during maternity and infancy, including medical, surgical and related services; to provide medical care and service to crippled and physically handicapped children; to enable each state to extend and improve public health work, including facilities for the control of tuberculosis, malaria, pneumonia, cancer, mental health and industrial hygiene activities; to make investigations of disease, health and sanitation and matters pertaining thereto; to enable each state to construct, improve and maintain needed hospitals and health centers; to enable each state to extend and improve general medical care; to assist states in the development of plans for temporary disability compensation, where disability does not arise out of or in the course of employment.

The bill does not seek to establish a system of health insurance or require the states to do so, but provides for carrying out some of the phases of the National Health Program.

Committee on Legislation,
A. B. PATTERSON, *Chairman,*
CHARLES D. COLE, *Vice-Chairman.*

Air view of Milwaukee downtown area.

AMERICAN DENTAL ASSOCIATION GROUP INSURANCE PLAN

THE steady growth of the American Dental Association group insurance has made it a matter of personal interest to such a large number of the members of the Association that each year it is deserving of increased support by all local, state and national officers and the official journals of all component societies. Every member who is eligible should investigate this service of the A.D.A. and avail himself of this important adjunct to membership.

In order to provide the answers to some of the most common questions, the following description of the plan and its advantages was prepared by the Insurance Committee of the A.D.A.

THE REASON FOR A.D.A. SPONSORSHIP

The basic idea of group insurance (by this, *all* group insurance is meant) is to provide protection for the individual at the lowest possible cost during the period of his greatest productivity, when he is preparing himself for old age and retirement. Only by the use of the collective purchasing power of the entire group can this be accomplished; therefore, the plan must be suited to the average requirements as well as providing stability, flexibility and permanency. Since this could be accomplished without cost to the A.D.A., and since such a service is a distinct advantage to the members, sponsorship was the only logical answer to popular demand.

THE COMPANY CARRYING THE RISK

The largest and strongest company available to carry the A.D.A. group insurance was and is the Great-West Life Assurance Company, and to that company the insurance has been awarded. The Great-West has total assets of approximately $160,000,000 and more than $500,000,000 of insurance in force. It enjoys the highest rating awarded any company by all recognized authorities because of its unusual financial stability and able management. The record shows that every legitimate A.D.A. claim presented to the Great-West has been promptly paid in full.

CLAIM RECORD

Since the inception of the A.D.A. group insurance plan, 825 claims have been paid, totaling $1,888,238.85. This is as of March 1, 1939.

WHO IS ELIGIBLE

Every member in good standing in the A.D.A. who is not past age 50 is eligible to apply for the insurance. Evidence of good health is also a requirement for entry, but this is usually limited to a short nonmedical application form. Once a member is insured, he may continue the group insurance as long as premiums are paid and membership in good standing is maintained, but not past age 75. Conversion into an individual policy is allowed at age 51 or 75 without any insurability requirement. A more detailed description of this conversion privilege will be found elsewhere in this article.

COST OF INSURANCE

All policies are issued for the same amount, $3,000, and premiums are payable either annually or semi-annually January 1 and/or July 1 of each year. The age of the individual member determines the cost, which is divided into four age groups as follows:

Ages	Amount	Annual Cost	Semi-Annual Cost
21 to 30	$3,000	$18.50	$ 9.50
31 to 40	3,000	24.50	12.50
41 to 50	3,000	32.00	16.25
51 to 75	(For renewal only)	49.40	24.95

The cost represents a savings of approximately 40 per cent, on the average, over that of any similar coverage available to members as individuals.

PROTECTION

It must be borne in mind that the A.D.A. group insurance provides only protection. It is not combined with any investment feature as are "ordinary life," "limited payment" and "endowment" policies. In other words, there are no "cash values" (money belonging to the individual insured) to reduce the amount the company is called upon to pay in event of a claim. The difference in cost, accumulated from year to year, will more than equal the "cash value" of an individual policy, and this accumulation should, therefore, be considered as an increase in the amount of protection when making comparisons. For this reason, we call the A.D.A. group insurance pure protection.

AGE 51 AND OVER, AND CONVERSION PRIVILEGE

It has been found that any plan whereby the cost increases at later ages (when the income of the average member is decreasing) is frequently interpreted as a means of "freezing the old man out," even though that is not the object. If the cost to the older member is not increased, it must be added to the young member's cost (since the increased mortality rate must be met) and the younger members criticize the plan as being one whereby "the young man carries the older man's insurance." In order to have each group independently carrying its own burden, and at the same time to eliminate the accusation of a "freeze-out," the A. D. A. group plan was worked out to provide for a slight reduction in the amount of insurance each year, starting with age 53. This was done to offset the increased mortality cost at the later ages and yet keep the premium within moderate means and constant. Any plan adopted had to deal in averages, and our plan is based on the assumption that the individual has less and less need for pure protection during his advanced years and should be approaching retirement.

In order to eliminate the possibility of any member being seriously injured by the annual reduction in the amount of insurance provided (starting with age 53), and at the same time inject enough flexibility to take care of the individual who would not be handicapped by the increased cost necessary to maintain the full $3,000, the Insurance Committee secured an additional conversion privilege from the Company. This gives the insured member the choice, when he reaches age 51, of either remaining in the group or of converting his insurance into an individual policy, without regard to his possible physical condition at that time, at the standard (select risk) rate. Not only does he have this unusual privilege, but also he is reminded of it at the time when it is available. The fact that so few have availed themselves of the privilege is proof that they endorse the "average needs" theory and are able to appreciate the large savings in cost afforded them by the group insurance.

A considerable amount of space has been devoted to the "age 51 and over" situation, because it is the only point on which there seems to be any question and the committee feels sure that no member can seriously object to the plan once the problem it meets is understood.

ADDITIONAL INFORMATION

Additional information or an application blank may be secured by writing to Fred A. Richmond, Insurance Secretary, A. D. A., Huron Bldg., Kansas City, Kan.

Insurance Committee, A. D. A.,
A. D. WEAKLEY, *Chairman,*
1029 Vermont Ave.,
Washington, D. C.

AMERICAN DENTAL ASSOCIATION

Eighty-First Annual Session

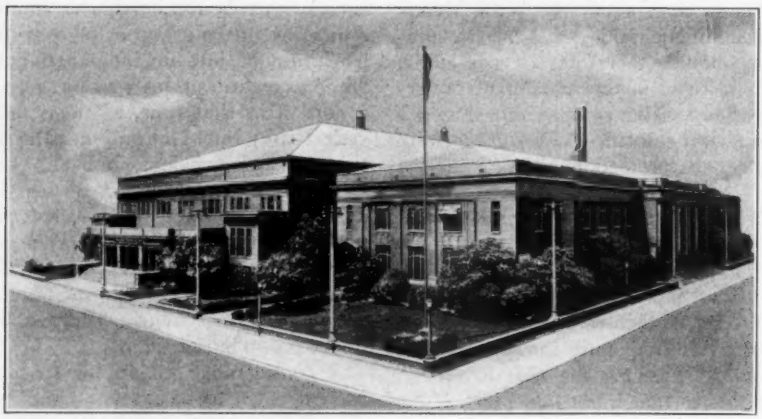
Milwaukee, Wis., July 17-21, 1939

MILWAUKEE, the "meeting place of the great councils," will be the scene of the Eighty-First Annual Session of the American Dental Association.

Here, from July 17 through July 21, an anticipated record crowd of members of the profession from all parts of the country and from foreign lands as well will hold the 1939 "pow-pow" on the site of historic Indian councils of years ago.

"The fine land," Miloaki, was the camp site of the Red Man before the White Man came, and here was smoked the Pipe of Peace as the chiefs shaped the destiny of Redskin nations of the Middle West.

Out of the Indian camp site grew a village. To the village came the white trader and the settler, and from this beginning grew Milwaukee, known all over the country for its capabilities as a convention city.



Milwaukee Auditorium, one of the most complete and serviceable buildings of its kind in America; located in the center of the hotel, theater and shopping district.

National meetings are attracted to this city on the western shore of Lake Michigan for many of the reasons that brought the Indian councils here. Milwaukee enjoys a reputation as a summer resort city, and within an hour's drive of the center of town, visiting members of A.D.A. will find one of the real vacation playgrounds of America.

Milwaukee is the thirteenth largest city in the United States, having a pop-

ulation of 624,243. It is one of the "model" cities of the country from the standpoints of education, safety, health and crime rate. It is truly a metropolitan city, offering the convention throngs first class hotel facilities, numerous excellent restaurants and night clubs, eighty motion picture houses, two legitimate theaters, art galleries, a world-renowned zoo, museums, libraries and a host of other points of interest.

East Wisconsin Ave., Milwaukee, from the Milwaukee River.

The headquarters of the Eighty-First Session of the American Dental Association will be the palatial Hotel Schroeder. The exhibits and section meetings will be housed in the Milwaukee Auditorium, one of the outstanding structures of its kind. Physically and mechanically, Milwaukee is well prepared to play host to the A.D.A., but what it is more proud of is its "spirit of real hospitality"—a natural, sincere effort to make its visitors feel at home.

Members of the profession planning a family vacation in connection with the meeting will find 163 inland lakes within an hour's drive of the city. Here are offered swimming, fishing, boating and other recreational activities. Within the city are eight fine public golf courses, and courtesies will be extended to members of the profession at the numerous private country clubs.

The 7,000 lakes, innumerable rivers and 10,000 miles of trout streams have brought Wisconsin world fame as a fine

fishing state. The truly wonderful thing about this is that there are not only excellent fishing waters, but also *fish*. Wisconsin is sufficiently farsighted to know that in this day of dense population and easy travel, good fishing is not a gift of the gods. Good fishing must be backed by plans to preserve and maintain the fish population, and that inevitably means the conservation and propagation of fish.

Wisconsin annually propagates and distributes more fish in its lakes and streams than does any other state. In 1938, for the second consecutive year, the planting program passed the billion mark. The total for this year was 1,121,938,399; the 1937 total, 1,096,734,759 fish propagated and planted. No wonder fishing is good in Wisconsin! In this distribution for 1937 and 1938, there was included a total of 47,839,362 muskellunge, considered the king of all fresh water fish, and for which Wisconsin has long been famous.

Meanwhile, those inclined will find facilities for tennis, polo, horseshoe pitching, archery, baseball and other sports. The entire Milwaukee-Lake Michigan shoreline is a park area dotted with a dozen bathing beaches.

Even now, Milwaukee is preparing to welcome the Eighty-First Session of the American Dental Association, extending a welcome to the "meeting place of the great councils." Here, from July 17 through July 21, members of the profession will "smoke the Pipe of Peace" and trade thoughts on the latest developments in dentistry.

Milwaukee's Court of Honor, its memorial to all veterans. From it can be seen the downtown area, with the Hotel Schroeder on the right.

D. P. NACHAZEL, *Chairman,*
Publicity Committee,
239 W. Center St.,
Milwaukee, Wis.

RESEARCH COMMISSION

SUPPLEMENTAL RÉSUMÉ OF THE RESEARCH ACTIVITIES OF ORGANIZED DENTISTRY, LISTING PUBLISHED REPORTS AND PAPERS*

By HOMER C. BROWN, D.D.S., F.A.C.D., Columbus, Ohio

(Continued from March Issue)

CALIFORNIA (SOUTHERN) GROUP
(Continued)

Studies in Paleodontology. XXI. Further Note Concerning the Association of Arthritis with Diseased Teeth. *Pac. D. Gaz.*, November 1929.

Studies in Paleodontology. XXVI. Deformed Molar of a Mammoth from the Pleistocene of Texas. *Pac. D. Gaz.*, November 1929.

Studies in Paleodontology. XXV. California Sabre-Tooth, Facial Asymmetry Following Loss of Sabre. *Pac. D. Gaz.*, December 1929.

Studies in Paleodontology. XVII. California Sabre-Tooth, Two Impactions and an Abscess. *Pac. D. Gaz.*, December 1929.

Studies in Paleodontology. XXII. Apical Closure of Root Canals in Adult Pleistocene Carnivors. *Pac. D. Gaz.*, January 1930.

Rare Dental Mass Found in a Domestic Pig. *Pac. D. Gaz.*, February 1930.

Studies in Paleodontology. Teeth, Jaws and Palates of Pre-Pueblo Indians from New Mexico. *Pac. D. Gaz.*, March 1930.

Studies in Paleodontology. Tumors of the Mandible in Prehistoric Peru. *Pac. D. Gaz.*, May 1930.

Studies in Paleodontology. Dental Abscesses in a Dinosaur Millions of Years Old and the Oldest Yet Known. *Pac. D. Gaz.*, July 1930.

Studies in Paleodontology. Teeth of the Piros. *Pac. D. Gaz.*, December 1930.

FORSYTH DENTAL INFIRMARY GROUP

HOWE, P. R.: Dietic Effects in Oral Secretions. *D. Cosmos*, 1911, p. 43.

Effect of Scorbutic Diets upon the Teeth. *D. Cosmos*, 1920, p. 586.

Food Accessory Factors in Relation to the Teeth. *J. D. Res.*, 1921, p. 7.

Report on Studies of the Effect of Vitamin Deficient Diet upon the Teeth. *D. Cosmos*, 1921, p. 1086.

Further Studies of the Effect of Diet upon the Teeth and Jaws. J.A.D.A., 1922, p. 55.

Further Studies of the Effect of Diet upon the Teeth and Bones. J.A.D.A., 1923, p. 201.

Diet as Related to the Prevention of Mouth Disease. J.A.D.A., 1923, p. 755.

Decalcification of Teeth and Bones, and Regeneration of Bone Through Diet. *D. Summary*, 1923, p. 133.

Studies of Dental Disorders Following Experimental Feeding with Monkeys. J.A.D.A., 1924, p. 1149.

Some Experimental Effects of Deficient Diets on Monkeys. J.A.D.A., 1924, p. 1161.

Some Experimental Effects of Deficient Diets. *D. Summary*, 1924, p. 212.

Relative Importance of the Diet as a Factor in Dental Disease. *D. Summary*, 1925, p. 885.

(and S. B. WOLBACH): Tissue Changes Following Deprivation of Fat Soluble A Vitamin. *J. Exper. Med.*, Vol. 42, December 1925.

(and S. B. WOLBACH): Intercellular Substances in Experimental Scorbutus. *Arch. Path.*, 1926, pp. 1-24.

(and S. B. WOLBACH): Effect of a Deficiency of the Antiscorbutic Factor in Guinea-Pigs and the Fat Soluble A in Rats. J.A.D.A., 1926, p. 1592.

Effects of Fat Soluble A Deficiency on Epithelial Tissues. *Rockefeller J. Exper. Med.*, 1925.

Account of Progress in Dental Dietetic Research. *D. Cosmos*, 1926, p. 33.

Influence of Food on Malocclusion. *Internat. J. Orthodontia*, March 1927.

(and S. B. WOLBACH): Vitamin A Deficiency in the Guinea-Pig. *Arch. Path.*, February 1928, pp. 239-253.

Importance of the Diet During Prenatal

and Infant Life on the Development of Human Teeth. *D. Cosmos,* 1928, p. 9.

Diet as a Fundamental in Dental Conditions. J.A.D.A., 1928, p. 1673.

Calcium Fixation. J.A.D.A., 1930, p. 736.

(RUTH L. WHITE and MILTON RABINE): Retardation of Dental Caries in Outpatients of a Dental Infirmary. *Am. J. Dis. Child.,* 1933, pp. 1045-1049.

(and S. B. WOLBACH): Incisor Teeth of Albino and Guinea Pigs in Vitamin A Deficiency and Repair. *Am. J. Path.,* May 1933.

(and S. B. WOLBACH): Epithelial Repair in Recovery from Vitamin A Deficiency. *J. Exper. Med.,* March 1933, pp. 511-526.

(and M. A. LOGAN): Calcium and Ammonium Excretion in the Urine of Rabbits. *J. Biol. Chem.,* May 1935.

(and M. A. LOGAN): Composition of Cartilage, Bone, Dentin and Enamel. *J. Biol. Chem.,* July 1935.

GALLIE, D. M.: President's Address (Reference to Research Commission). N.D.A. Trans., 1915, p. 373.

HARTZELL, T. B., and MESSNER, C. T.: Report of Research Commission. A.D.A. Trans., 1933.

Report of Research Commission. A.D.A. Trans., 1933.

Report of Research Commission. A.D.A. Trans., 1934.

HETRICK, F. O.: President's Address (Reference to Research Commission). N.D.A. Trans., 1913, pp. 41-43.

Chairman's Report, Research Commission, A.D.A. Trans., 1924, pp. 182-193.

Chairman's Report, Research Commission. A.D.A. Trans., 1925, pp. 115-117.

Chairman's Report, Research Commission. A.D.A. Trans., 1926, pp. 70-85.

HINMAN, T. P.: President's Address (Reference to Research Institute). N.D.A. Trans., 1916, pp. 366-369.

[NOTE.—Without making a specific record, most of the subsequent Presidents incorporated a paragraph in their addresses relating to the activities of the Research Commission, some of whom made specific recommendations as to changes in policies, etc.]

JOHNS HOPKINS GROUP

KLEIN, HENRY, et al.: Relation of Diet to Skeletal Development of Swine, Including Development of Teeth. J.A.D.A., May 1930.

KLEIN, HENRY, and MCCOLLUM, E. V.: Age as a Factor in Calculation of Relative Percentage Incidence of Dental Caries in Rats on Stock and Deficient Diets. Preliminary Report. *J. D. Res.,* 1931, pp. 745-746.

KLEIN, HENRY: Lead Sector-Disc for Expressing Dentistry of Bone and Tooth Structure in Terms of Percentage Transmission of X-Rays. *J. D. Res.,* 1930, pp. 447-450.

Physico-Chemical Studies on Structure of Dental Enamel; Quantitative Method for Determining Relative Differences in Permeability of Teeth. *J. D. Res.,* 1930, pp. 447-450.

Etiology of Enamel Hypoplasia in Rickets as Determined by Studies on Rats and Swine. J.A.D.A., 1931, pp. 866-884.

Physico-Chemical Studies on Structure of Dental Enamel; Method for Determining Rate at Which a Salt May Penetrate Enamel. *J. D. Res.,* 1930, pp. 727-731.

LOUISVILLE GROUP

BEUST, T. B.: Are the Capillaries of Enamel Capable of Sustaining Metabolism? *D. Cosmos,* February 1914.

Micro-Biologic Aspect of Some Dental Inflammation. *D. Summary,* April 1918.

Is a Pulpless Tooth a Dead Tooth? *D. Cosmos,* October 1923.

Value of Elective Localization Phenomena, Etc. J.A.D.A., June 1923.

Nutrition of the Enamel. *D. Summary,* June 1924.

Physiological Changes in the Enamel After Tooth Eruption. J.A.D.A., May 1924.

Remarks on the Stratification of the Enamel. *D. Cosmos,* June 1924.

Contribution to the Etiology of Mottled Enamel. J.A.D.A., September 1925.

Capillaries of the Enamel and Their Relation to Mottled Teeth. J.A.D.A., July 1926.

Cemento Dentinal Junction. *D. Cosmos,* November 1926.

Pleomorphism of the Fusiform Bacillus. *Dutch D. J.,* June 1926.

Morphology of the Micro-Organisms of the Oral Flora. J.A.D.A., March 1927.

Growth of the Mandible of the Pig. *J. D. Res.,* February 1928.

Matrix Forming Organisms of the Dog. *J. D. Res.,* June 1929.

Intrafollicular Enamel Development. J.A.D.A., November 1928.

Morphology and Growth of the Fusiform Bacillus. J.A.D.A., April 1929.

Spirochetes and Fusiform Bacilli. J.A.D.A., August 1929.

Oral Organisms of the Dog. *J. D. Res.,* June 1929.

Microbial Phase of the Oral Manifestations of Vincent's Infections. *J. D. Res.,* January 1930.

Oral Manifestations and Treatment of Vincent's Infection. *J. D. Res.,* February 1930.

Tufts and Lamellae in Relationship to Posteruptive Form Changes in the Enamel. J.A.D.A., April 1930.

Micro-Organisms and Caries. J.A.D.A., August 1930.

Reactions of the Dentinal Fibril to External Irritation. J.A.D.A., June 1931.

Physiologic Changes in the Dentin. *J. D. Res.*, April 1931.

Posteruptive Changes as the Tooth Matures. J.A.D.A., November 1931.

Resistance to Caries. *J. D. Res.*, August 1931.

Enamel Tufts and Caries. J.A.D.A., March 1932.

Vincent's Infection. *Bull. Kentucky D. A.*, October 1931.

Germ Life in the Human Mouth. *Bull. Kentucky D. A.*, February 1932.

Critical Review of the C. F. Bodecker Theory of Resistance to Caries. *D. Cosmos*, June 1932.

Occurrence of Enamel Tufts. *J. D. Res.*, August 1932.

Reactions of the Dentin to Advancing Caries. *Bull. Kentucky D. A.*, October 1932.

Reactions of the Dentin to Advancing Caries. J.A.D.A., April 1933.

Inflammatory Zones in the Dentin. *J. D. Res.*, October 1933.

Demonstration of Sclerosis of Dentin in Tooth Maturation and Caries. *D. Cosmos*, March 1934.

Permeability Tests on Teeth with Pulpal Involvement. *J. D. Res.*, April 1934.

Panel Discussion on Dental Caries. *J. Pediat.*, December 1934.

Development of Dentin Sclerosis. J.A.D.A., July 1935.

[NOTE.—The following ten papers have been presented since 1935.—H.C.B.]

Micro-Organisms of Gingival Inflammations. (Read at the meeting of the Ohio State Dental Society, November 1934.)

Enamel and Dentin Metabolism Illustrated by the Reactions to Caries. J.A.D.A., 1936, p. 827.

Microbiology of Gingival Inflammations. (Read at the meeting of the Dental Section of the American Association for the Advancement of Science, St. Louis, Mo., January 4, 1936.)

Reaction of Tooth to the Advance of Decay. (Read before the Bluegrass Dental Society, Lexington, Ky., March 1936.)

Contact-Point Caries. (Read before the International Association for Dental Research, Louisville, Ky., March 1936.)

Microscopic Anatomy of Enamel. (Read before the International Association for Dental Research, Louisville, Ky., March 1936.)

Presidential Address. (Read before the International Association for Dental Research, Louisville, Ky., March 15, 1936.)

Tooth Attachment and Tooth Replacement in Sphyraena Barracuda. (Read before the Kentucky Academy of Science, Bowling Green, Ky., May 9, 1936.)

Morphology of the Fusiform Bacillus. *J. D. Res.*, October 1937, p. 379.

Genesis of the Periodontium. J.A.D.A., 1938, p. 114.

MICHIGAN GROUP

BUNTING, R. W., and RICKERT, U. G.: Dental Caries. N.D.A. Bull., October 1914, pp. 16-44.

The Tooth, a Permeable Membrane. J.N.D.A., May 1918, pp. 519-526.

RICKERT, U. G., and PALMERLEE, FAITH: (I) A Comparative Study of Total Salivary and Blood Calcium in Varying Types of Individuals with Special Reference to Cases of Pregnancy. (II) Focal Infection. J.A.D.A., September 1924, pp. 783-791.

MINNESOTA GROUP

HARTZELL, T. B.: Two Preliminary Reports. N.D.A. Bull., March 1914, pp. 4-9.

Report of the Mouth-Infection Research Corps. N.D.A. Bull., October 1914, pp. 48-70.

(W. F. CANTWELL and W. F. LARSON): Influence of the Surface Tension of the Culture Medium on the Growth of Bacteria. *J. Infect. Dis.*, July 1919, J.N.D.A., February 1920, p. 205.

Ten Years to Life. J.A.D.A., October 1922.

Discussion of the Factors to Be Considered in Determining Whether to Extract or Conserve Diseased Teeth. *Am. J. Surg.*, May 1919.

Microscopic Study of Pulps from Infected Teeth. J.N.D.A., March 1921, pp. 213-216.

Mouth as a Factor in the Pathogenesis of Ear, Kidney and Joint Inflammations. *Journal-Lancet*, April 1916.

Philosophy Underlying the Processes of Mouth Nutrition. J.A.D.A., January 1924, p. 25.

Discussion of the Essential Factors in the Treatment of Pyorrhea. *D. Items Int.*, January 1919.

Etiology and Development of Glomerulonephritis. *Arch. Int. Med.*, June 1922, pp. 768-820.

Report of the Mouth-Infection Research Corps of the National Dental Association. J. N.D.A., November 1916, pp. 333-362.

Etiological Relation of Focal Infections to Remote Disease. J.N.D.A., September 1921, pp. 739-746.

Spontaneous Nephritis in Rabbits and Its

Relation to Chronic Nephritis in Man. J.N.D. A., June 1921, pp. 461-467.

Microscopic Study of Pulps from Infected Teeth. *J. D. Res.*, December 1920.

Dental Path: Its Importance as an Avenue to Infection. *Surg., Gynec. & Obst.*, January 1916, pp. 18-27.

Microscopic Anatomy of Chronic Periodontitis and Pathogenesis of Dental Root Cysts. J.N.D.A., October 1917, pp. 1061-1074.

Review of the Literature Regarding Infected Teeth. J.A.D.A., April 1926.

Report of Five Recently Cured Pyorrhea Cases. *D. Cosmos*, May 1928.

Can Pyorrhea Be Cured? *Popular Health Dental Supplement*, May 1926.

Explanation of the Failure of the Dental Profession to Prevent Dental Disease. *D. Cosmos*, 1927, p. 1095.

Chronic Infections of the Mouth and of the Teeth and the Tissues Investing Them. J.A.D.A., July 1927.

Important Factors in the Etiology and Control of Periodontoclasia. J.A.D.A., May 1927.

Showing the Possibilities of Starch Digestion in the Mouth. J.A.D.A., January 1923.

Pathogenicity of Mouth Streptococci and Their Rôle in the Etiology of Dental Diseases. J.N.D.A., May 1917, pp. 477-499.

Clinical Type of Arthritis Originating About the Teeth. *J.A.M.A.*, September 25, 1915, pp. 1093-1096.

Gas (N_2O) and Oxygen Analgesia for Conservative Operations. *D. Cosmos*, January 1917.

Further Studies of the Etiology of Dental Caries. J.A.D.A., July 1925.

Etiology of Pyorrhea Alveolaris, with a Simplified Treatment. J.A.D.A., December 1925.

Review of the Literature Regarding Infected Teeth. J.A.D.A., April 1926.

Bacteria. J.A.D.A., March 1928.

Predisposing Causes of Pyorrhea Alveolaris. J.A.D.A., April 1929.

Interesting Cases of Advanced Periodontoclasia Before and After Treatment. J.A.D.A., July 1929.

Patient's Needs. J.A.D.A., October 1930, pp. 1833-1836.

Pulpless Tooth. *D. Cosmos*, November 1930.

Tainted Breath or Halitosis. J.A.D.A., June 1931, pp. 1110-1112.

Partial Denture vs. Fixed Bridgework, with Special Reference to the Treatment of Investing Tissues. J.A.D.A., July 1931, pp. 1304-1307.

Relation of Digestion to Tongue Surface Putrefaction and Periodontoclasia. *J. Periodontol.*, July 1931.

Prophylaxis and Pyorrhea. J.A.D.A., February 1932, pp. 260-265.

LARSON, W. P.: Further Observations on the Connellan-King Diplococcus Throat Infections: Their Sequelae, with Especial Reference to Arthritis. J.N.D.A., 1918, p. 207.

(T. B. HARTZELL and H. S. DIEHL): Effect of High Pressure on Bacteria. J.N.D.A., 1918, pp. 396-420.

(and E. T. BELL): Perfusion Experiment in the Study of Cellular Anaphylaxis. J.N.D.A., 1919, pp. 453-457. A Report of Investigations Completed During the Past Year and Those Now in Progress at the University of Minnesota (Bacterial Research). J.N.D.A., 1919, pp. 640-642.

(W. F. CANTWELL and T. B. HARTZELL): Influence of the Surface Tension of the Culture Medium on the Growth of Bacteria. J.N.D.A., 1920, pp. 205-208.

(and T. B. HARTZELL): Preliminary Report of Some Experiments on the Destruction of Human Tooth Enamel. J.A.D.A., 1924, pp. 649-652.

(and T. B. HARTZELL): Further Studies of the Etiology of Dental Caries. J.A.D.A., 1925, pp. 748-786.

(and T. B. HARTZELL): Further Observations on the Detoxification of Bacterial Toxins. J.A.D.A., 1926, pp. 1147-1150.

HENRICI, A. T. (and T. B. HARTZELL): Study of Streptococci from Pyorrhea Alveolaris and from Apical Abscesses. *D. Digest*, 1915, pp. 589-590.

(and T. B. HARTZELL): Oral Prophylaxis in Its Relation to Pyorrhea and Its Treatment. J.N.D.A., 1915, pp. 122-142.

(and T. B. HARTZELL): Etiology of Dental Abscess: Acute and Chronic. *Panama-Pacific D. Cong.*, Vol. 1, 1915, pp. 162-164.

(HAROLD J. LEONARD and T. B. HARTZELL): Report of the Minnesota Division of the Scientific Foundation and Research Commission (Mouth Infections in Relation to Systemic Disease). J.N.D.A., 1915, pp. 333-353.

(and T. B. HARTZELL): Dental Pathology, Its Importance as an Avenue to Infection. *D. Cosmos*, 1916, p. 570.

Specificity of Streptococci. J.N.D.A., 1917, pp. 164-165.

Microscopic Anatomy of Chronic Periodontitis and Pathogenesis of Dental Root-Cysts. J.N.D.A., 1917, pp. 1061-1074.

(and T. B. HARTZELL): Bacteriology of Vital Pulps. J.N.D.A., 1920, pp. 375-377.

BELL, E. T. (and W. P. LARSON): Perfusion Experiment in the Study of Cellular Anaphylaxis. J.N.D.A., 1919, pp. 453-457.

(and T. B. HARTZELL): Effect of Foreign Protein on the Kidney. J.N.D.A., 1920, pp. 208-214.

Spontaneous Nephritis in Rabbits and Its

Relation to Chronic Nephritis in Man. J.N. D.A., 1921, pp. 461-467.

(B. J. CLAWSON and T. B. HARTZELL): Experimental Glomerulonephritis (Invasion Through the Mouth). *D. Cosmos,* 1928, pp. 757-765.

GREY, W. A. (T. B. HARTZELL and A. T. HENRICI): Report of the Mouth-Infection Research Corps of the National Dental Association. J.N.D.A., 1916, pp. 333-362.

EPSTEIN, I. A.: Study of the Blood in Cases with Dental Infection: Preliminary Report. J.A.D.A., 1926, pp. 1752-1764.

Qualitative and Quantitative Consideration of the Cells in Normal Blood. J.A.D.A., 1928, pp. 1055-1071.

Blood Examination in the Practice of Dentistry (Oral Diagnostics). J.A.D.A., 1929, pp. 1808-1820.

GROVE, C. J.: Accurate New Technic for Filling Root Canals to the Dentinocemental Junction with Impermeable Materials. J.A. D.A., 1929, pp. 1594-1600.

Why Root Canals Should Be Filled to the Dentinocemental Junction. J.A.D.A., 1930, pp. 293-296.

Why Root Canals Should Be Filled to the Dentinocemental Junction (A Reply to Dr. Skillen's Criticism). J.A.D.A., 1931, pp. 314-319.

MCCAULEY, C. M.: Great Need of Improvement in the Manufacture of Dental Alloys. N.D.A. Trans., 1912, pp. 127-136.

NATIONAL BUREAU OF STANDARDS GROUP

TAYLOR, N. O.: Mechanical Amalgamation: Progress Report of Research on Dental Materials. J.A.D.A., April 1929, p. 583.

Survey of Amalgam Alloys: Report to the Research Commission of the American Dental Association. J.A.D.A., 1929, p. 590.

SOUDER, WILMER: Physical Properties of Dental Materials (Some Laboratory Experiments for the Dental Schools). J.A.D.A., 1929, p. 1829.

TAYLOR, N. O.: Specification for Dental Amalgam Alloys: Report to the Scientific Foundation and Research Commission of the American Dental Association. J.A.D.A., 1930, p. 112.

Progress Report on Research on Dental Materials (II). The Research Program. J.A.D.A., May 1930, p. 775.

SOUDER, WILMER, and SWEENEY, W. T.: Tentative Specifications for Dental Casting Investment. J.A.D.A., May 1930, p. 780.

SOUDER, WILMER: Value of Dental Research Appreciated by the Profession. *Iowa D. Bull.,* June 1930, p. 81.

Problems in Dental Research. *J. D. Res.,* October 1930, p. 547.

TAYLOR, N. O.: Amalgam Technic: Dangerous and Dependable Practices. J.A.D.A., October 1930, p. 1880.

(and G. C. PAFFENBARGER): Survey of Current Inlay Casting Technics. J.A.D.A., November 1930, p. 2058.

(G. C. PAFFENBARGER, and W. T. SWEENEY): Dental Inlay Casting Investments: Physical Properties and a Specification. J.A. D.A., December 1930, p. 2266.

(W. T. SWEENEY and G. C. PAFFENBARGER): Specification for Inlay Casting Wax. J.A.D.A., January 1931, p. 40.

(W. T. SWEENEY and G. C. PAFFENBARGER): Specification for Dental Impression Compound. J.A.D.A., January 1931, p. 53.

Progress Report: Research on Dental Materials; Research Program: Cooperative Work on Inlay Casting Technic. J.A.D.A., February 1931, p. 294.

Standards for Dental Materials. *Iowa D. Bull.,* 1931, p. 89.

PAFFENBARGER, G. C., and SWEENEY, W. T.: Dental Casting Technic: Theory and Practice. *J. D. Res.,* October 1931, p. 681.

TAYLOR, N. O.: Problems Involved in the Study of Wrought Gold Alloys for Orthodontia. *Internat. J. Orthodontia,* November 1931, p. 1033.

SOUDER, WILMER, and SWEENEY, W. T.: Is Mercury Poisonous in Dental Amalgam Restorations? *D. Cosmos,* December 1931.

TAYLOR, N. O., PAFFENBARGER, G. C., and SWEENEY, W. T.: Inlay Casting Golds: Physical Properties and Specifications. J.A.D.A., January 1932, p. 36.

ISAACS, AARON: Mercury for Dental Amalgams. J.A.D.A., 1932, p. 54.

VOLLAND R. H., and PAFFENBARGER, G. C.: Cast Gold Inlay Technic as Worked Out in the Cooperative Research at the National Bureau of Standards and Applied by a Group of Practicing Dentists. J.A.D.A., February 1932, p. 185.

TAYLOR, N. O., and PAFFENBARGER, G. C.: Progress Report on Research on Dental Materials (1931). J.A.D.A., March 1932, p. 404.

TAYLOR, N. O., PAFFENBARGER, G. C., and SWEENEY, W. T.: Study of Wrought Gold Alloys: Preliminary Report. J.A.D.A., March 1932, p. 410.

PAFFENBARGER, G. C.: Dental Research at the National Bureau of Standards. *Xi Psi Phi Quart.,* May 1932, p. 386.

PAFFENBARGER, G. C., SWEENEY, W. T., and ISAACS, AARON: Wrought Gold Wire Alloys: Physical Properties and a Specification. J.A.D.A., 1932, p. 2061.

SWEENEY, W. T.: Cristobalite for Dental

Investment. J.A.D.A., January 1933, p. 108.

PAFFENBARGER, G. C., and SWEENEY, W. T.: Third Survey of Dental Amalgam Alloys. J.A.D.A., April 1933, p. 649.

SOUDER, WILMER: Science Aids in Improving Dental Restorations. *J. D. Res.,* April 1933, p. 154.

PAFFENBARGER, G. C., and SWEENEY, W. T.: Progress Report on Research on Dental Materials. J.A.D.A., May 1933, p. 885.

SOUDER, WILMER: Time Required to Cast Dental Restorations from Molten Alloy. J.A.D.A., June 1933, p. 1010.

Research Commission: Dental Research Fellowship at the National Bureau of Standards. J.A.D.A., 1933, p. 1040.

PAFFENBARGER, G. C., SWEENEY, W. T., and ISAACS, AARON: Preliminary Report on the Zinc Phosphate Cements. J.A.D.A., November 1933, p. 1960.

SOUDER, WILMER: Fifteen Years of Dental Research at the National Bureau of Standards. J.A.D.A., January 1934, p. 58.

PAFFENBARGER, G. C., and SWEENEY, W. T.: Specifications and Certifications for Dental Materials. J.A.D.A., April 1934, p. 658.

Second Survey of Dental Impression Compounds and of Inlay Casting Waxes. J.A.D.A., April 1934, p. 657.

PAFFENBARGER, G. C., SWEENEY, W. T., and ISAACS, AARON: Zinc Phosphate Cements: Physical Properties and a Specification. J.A.D.A., November 1934, p. 1907.

BARBER, RONALD: Preliminary Tests of Some of the Newer Denture Materials. J.A.D.A., November 1934, p. 1969.

MESSNER, C. T.: Revised List of Dental Materials Certified to the Research Commission of the American Dental Association. J.A.D.A., November 1934, p. 2026.

PAFFENBARGER, G. C., and SWEENEY, W. T.: Dental Research at the National Bureau of Standards in Relation to Orthodontia. *Internat. J. Orthodontia,* December 1934, p. 1166.

Research Commission: Investigation of "Chief" White Gold "Castloy." J.A.D.A., February 1935, p. 348.

VOLLAND, R. H.: American Dental Association's Affiliation with the National Bureau of Standards. J.A.D.A., April 1935, p. 618.

Research Commission: Dental Research at the National Bureau of Standards. J.A.D.A., April, 1935, p. 625.

Research Commission: Certified Amalgam Alloys: A.D.A. Specification No. 1. J.A.D.A., June 1935, j. 1028.

[NOTE.—The following nineteen items have been published since the presentation of my 1935 paper.—H.C.B.]

VOLLAND, R. H., PAFFENBARGER, G. C., and SWEENEY, W. T.: Study of Zinc Phosphate Cement by a Group of Practicing Dentists Under the Direction of the A.D.A. Research Fellowship at the National Bureau of Standards. J.A.D.A., August 1935, p. 1281.

Research Commission: Revised List of Certified Inlay Casting. Investments. J.A.D.A., August 1935, p. 1384.

Revised List of Certified Impression Compounds. J.A.D.A., October 1935, p. 1742.

SOUDER, WILMER: Standards for Dental Material. J.A.D.A., November 1935, p. 1873.

Standards for Orthodontic Materials. *Internat. J. Orthodontia,* November 1933, p. 1003.

Research Commission: Certified Zinc Phosphate Cements. J.A.D.A., 1935, p. 1281.

SWEENEY, W. T., and SCHOONOVER, I. C.: Progress Report on Denture Base Material. J.A.D.A., August 1936, p. 1498.

PAFFENBARGER, G. C., and SOUDER, WILMER: Physical Properties of the Zinc Phosphate Cements. *Proc. IX Internat. D. Cong.,* August 1936, p. 347.

SOUDER, WILMER: Research on Dental Materials Brings Improved Dental Service. *Proc. IX Internat. D. Cong.,* August 1936, p. 1231.

Research Commission: List of Certified Products. J.A.D.A., August 1937, p. 1355.

Certified Wrought Gold Wire Alloys. J.A.D.A., October 1937, p. 1702.

SOUDER, WILMER: Dentists Rely on Standards. *Indust. Standard. & Commer. Standards Month.,* October 1937, p. 275.

PAFFENBARGER, G. C., and BEALL, J. R.: American Dental Association Specification No. 8 for Dental Zinc Phosphate Cement. J.A.D.A., December 1937, p. 2019.

PAFFENBARGER, G. C., SCHOONOVER, I. C., and SOUDER, WILMER: Dental Silicate Cements: Physical Properties and a Specification. J.A.D.A., January 1938, p. 32.

Research Commission: List of Certified Products. J.A.D.A., March 1938, p. 475.

Survey of Certified Amalgam Alloys. J.A.D.A., June 1938, p. 981.

PAFFENBARGER, G. C., and BEALL, J. R.: Investigation of Four Gypsum Materials Used to Prepare Indirect Inlay Models. J.A.D.A., July 1938, p. 1146.

SCHOONOVER, I. C., and SWEENEY, W. T.: Some Properties of Two Types of Resins Used for Dentures. J.A.D.A., September 1938, p. 1487.

LOWERY, P. C., and MESSNER, C. T.: Report Research Commission. A.D.A. Trans., 1935.

LOWERY, P. C., and KELSEY, H. E.: Report,

Research Commission. A.D.A. Trans., 1936.

Report, Research Commission. A.D.A. Trans., 1937.

LOWERY, P. C.: Program of the Research Commission at the National Bureau of Standards. J.A.D.A., July 1936.

Dental Research and Its Value to the Public. J.A.D.A., January 1937.

Report of Research Commission. J.A.D.A., February 1937, p. 269.

Policies of the Research Commission of the American Dental Association. J.A.D.A., April 1937.

Activities of the Research Commission at the National Bureau of Standards. J.A.D.A., August 1937.

Report of the Research Commission. Fiscal Year—July 1, 1936 to June 30, 1937. J.A.D.A., October 1937.

Brief Résumé of the Research Commission's Activities for 1937-1938. J.A.D.A., December 1938.

LOWERY, P. C., and LYNCH, D. F.: Report, Research Commission, Report of Officers and Committees, 1938, pp. 172-198.

MESSNER, C. T.: Secretary's Report, Research Commission. A.D.A. Trans., 1933.

Aims and Accomplishments of the Research Commission. J.A.D.A., 1934, pp. 1554-1565.

NEBRASKA GROUP

FOOTE, J. S.: (1) Bone as a Measurement of the Development. (II) When and How We Acquire Our Teeth.

(In 1928, these valuable contributions were published in book form, consisting of 182 pages. Copies are available in most dental and medical libraries and dental colleges. This publication was made possible through the cooperation of the Research Commission with Edward H. Bruening and associates affiliated with the Dental Department of Creighton University. Copies of this publication may be purchased from the Library Department of the American Dental Association as long as they are available. Dr. Foote's original manuscript, drawings and plates have been filed, as a permanent record, in the Smithsonian Institution at Washington.)

The Bowfin-Amia Calva: Histology of Bone and Teeth. J.A.D.A., June 1924.

THE NEW YORK INSTITUTE OF CLINICAL ORAL PATHOLOGY INC. GROUP

BLUM, THEODOR: Clinical Oral Pathology. *D. Cosmos,* November 1935.

KALETSKY, THEODORE, and FUREDI, ANNA: Investigation of the Reliability of Various Types of Pulp Testers as a Diagnostic Aid. J.A.D.A., September 1935.

FUREDI, ANNA: Study of the So-Called Osteofibromas of the Maxilla. *D. Cosmos,* October 1935.

NORTHWESTERN GROUP

HATTON, E. H.: Histopathology of Apical Region of Teeth with Partly Filled Root Canals. *J.A.M.A.,* Vol. 77, 1921, pp. 1805-1808.

Adenoma of Mucous Glands of Mouth and Macrocheilia. *D. Cosmos,* 1921, p. 552.

Occurrence, Differential Diagnosis and Treatment of Tuberculosis and Syphilis of the Mouth, and Acute Ulcerous Gingivitis. J.A.D.A., 1921, p. 1008.

Vitamin Deficiency Diseases and Their Relationship to Dentistry. J.N.D.A., 1922, pp. 762-767.

Possibility of Apical Regeneration After Root-Canal Filling from the Histopathological Point of View. J.A.D.A., 1922, pp. 192-198.

(and HERBERT POTTS). Osteitis Fibrosa. *J.A.M.A.,* Vol. 81, 1923, pp. 2015-2016.

Focal Infection and Dental Diseases. J.A.D.A., 1923, pp. 1136-1137.

Pathology of Suppurative Pericementitis with Special Reference to Its Surgical Treatment. *Chicago D. Soc. Bull.,* February 22, 1924, pp. 3-8.

Focal Infection. J.A.D.A., 1924, pp. 618-625.

Preliminary Report Concerning Alterations in the Blood and Saliva. J.A.D.A., 1924, pp. 116-167.

Mouth Infection. J.A.D.A., 1924, p. 1256.

Changes Produced by Disease in the Pulp and Periapical Regions and Their Relationship to Pulp-Canal Treatment and Systemic Disease. *D. Cosmos,* 1924, pp. 1183-1189.

Focal Infection from the Point of View of the Dentist. J.A.D.A., 1926, pp. 728-734.

Some Common Fallacies About Diseased Teeth (Diagnosis). *Chicago D. Soc. Bull.,* March 5, 1926, pp. 10-14.

RICKERT, U. G., HALL, E. M., and BLAYNEY, J. R.: Report of the Root-Canal Therapy Committee of the Chicago Dental Society. *Chicago D. Soc. Bull.,* June 18, 1926, pp. 7-20.

Dental Disease and General Health. J.A.D.A., 1926, pp. 1650-1651.

Regeneration of the Apical Region After Treatment and Filling of the Pulp Canals. J.A.D.A., 1926, pp. 485-488.

Some of the Conditions That Increase the Hazard of Surgical Procedures. J.A.D.A., 1927, pp. 2027-2031.

What Teeth Should Be Extracted: From

the Viewpoint of a Research Pathologist. J.A.D.A., 1928, pp. 1222-1225.

Bacterial and Histologic Findings After Present-Day Root Canal Treatment. *D. Cosmos*, 1928, pp. 924-926.

Histological Studies. *D. Cosmos*, 1928, pp. 250-253.

Focal Infection from the Point of View of the Dentist. *Pac. D. Gaz.*, 1928, pp. 115-122.

Some Errors in Root Canal Fillings. *D. Rec.*, 1928, p. 389.

Pulp Abscesses at the End of Guttapercha Fillings, Compared with X-Ray Findings. *J. D. Res.*, 1928, p. 219.

Fatty Changes in the Tooth and Investing Tissues. *J. D. Res.*, 1928, p. 417.

Infection of the Investing Tissues of the Teeth (With Special Reference to Treatment Including Extraction). *Ohio D. Soc. Bull.*, 1929, pp. 11-15.

Study of the Mouths of Identical Twins: Studies of the Anesthetic Properties of Several Procain Solutions; Certain Studies of Tissue Changes in the Peridental Membrane. J.A.D.A., 1929, pp. 2123-2125.

(and H. C. Benedict): What Is Research? Research in Fields Not Dental. J.A.D.A., 1929, pp. 38-39.

(and Warren R. Schramm): Bone Regeneration Following Extraction of Teeth in Dogs. *J. D. Res.*, 1929, pp. 272-273.

Pulp Pathology from the Standpoint of the Clinician. J.A.D.A., 1930, pp. 2262-2265.

Histologic Studies of Living Tissue Reactions Associated with Pulpless Teeth That May Be Taken as Evidence of a Satisfactory or Physiologic Healing. J.A.D.A., 1931, pp. 1502-1510.

Skillen, W. G.: Report on the Formation of Dentin and Cementum Relative to the Structure of the Root End. J.N.D.A., 1921, p. 3.

Histological and Pathological Studies of the Peridental Membrane, Cementum and Dentin with Reference to Infections. J.N.D.A., 1921, pp. 621-630.

Permeability—A Tissue Characteristic Involved in Root-Canal Treatment. J.N.D.A., 1922, pp. 187-191.

Some Characteristics of the Tissues Composing and Surrounding the Tooth-Root Applicable in the Prevention and Treatment of Infection. *D. Items Int.*, 1923, pp. 44-51.

Hard Tissue Changes Within the Canals of Treated Teeth, and Their Possible Significance. J.A.D.A., 1924, pp. 350-358.

Permeability of Enamel in Relation to Stains. J.A.D.A., 1924, pp. 402-404.

Certain Features Pertaining to the Pathology and Treatment of Chronic Suppurative Pericementitis (Pyorrhea). *Illinois D. Soc. Trans.*, 1924, pp. 85-86.

Status of the Treated Tooth. J.A.D.A., 1926, pp. 291-304.

Normal and Pathologic Anatomy of the Investing Tissues Relative to Chronic Pericementitis. J.A.D.A., 1926, pp. 1569-1585.

(Edward H. Hatton and O. H. Moen): Histologic Findings in Teeth with Treated and Filled Root Canals. *Internat. D. Cong. (Seventh) Trans.*, pp. 319-323; J.A.D.A., 1928, pp. 56-60.

(and Emil Mueller): Epithelium and the Physiologic Pocket. *Internat. D. Cong. (Seventh) Trans.*, pp. 402-417; J.A.D.A., 1927, pp. 1149-1164.

Pulpless Tooth from the Histologic Standpoint. J.A.D.A., 1927, pp. 500-504.

(and E. H. Hatton): Epithelial Changes in So-Called Pyorrhea. *J. D. Res.*, 1928, pp. 211-212.

Normal Characteristics of the Gingiva and Their Relation to Pathology. J.A.D.A., 1930, pp. 1088-1110.

Morphology of the Gingivae of the Rat Molar. J.A.D.A., 1930, pp. 645-668.

Why Root Canals Should Be Filled to the Dentinocemental Junction. J.A.D.A., 1930, pp. 2082-2090.

Normal Anatomic and Physiologic Gingiva and Its Relation to Pathologic Processes. J.A.D.A., 1931, pp. 600-615.

Case of Metastatic Carcinoma of the Jaws. J.A.D.A., 1930, pp. 1678-1687.

OHIO GROUP

Cape, A. T., and Kitchen, P. C.: Histologic Phenomena of Tooth Tissues as Observed Under Polarized Light; with a Note on the Roentgen-Ray Spectra of Enamel and Dentin. J.A.D.A., 1930, pp. 193-227.

PENNSYLVANIA GROUP

Prinz, Hermann, and Grossman, L. I.: Comparative Study of Root Canal Therapy with (I) Camphorated Chorphenol, and with (II) Electro-Sterilization. *D. Cosmos*, 1932, pp. 324-327.

UNITED STATES PUBLIC HEALTH GROUP

Dean, H. T.: Distribution of Mottled Enamel in the United States. J.A.D.A., 1933, p. 319.

Classification of Mottled Enamel Diagnosis. J.A.D.A., 1934, p. 1421.

(R. M. DIXON and CHESTER COHEN): Mottled Enamel in Texas. U. S. Public Health Reports Reprint No. 1678.

VOLLAND, R. H.: Secretary's Report, Research Commission. A.D.A. Trans., 1924, pp. 182-193; 1925, pp. 117-131; 1926, pp. 70-85; 1927, pp. 105-124; 1927, pp. 231-235.

WESTERN RESERVE GROUP

CHASE, S. W.: Origin, Structure, and Duration of Nasmyth's Membrane. *Anat. Rec.*, Vol. 33, 1926, pp. 357-376.

Number of Enamel Prisms in Human Teeth. J.A.D.A., 1927, pp. 491-492.

Enamel Prisms and Interprismatic Substance. *Anat. Rec.*, 1927, pp. 239-258.

Structure of the Dental Enamel. J.A.D.A., 1927, pp. 868-871.

Nerve Fibers and von Korpp's Fibers of the Dental Pulp. *Anat. Rec.*, Vol. 42, 1929, p. 10.

Additional Evidence of the Keratinous Nature of the Enamel Matrix. *J. D. Res.*, 1929, p. 288.

Some Uses for Dissolved Celluloid in the Preparation of Ground Sections of Bones and Teeth. *J. D. Res.*, 1933, pp. 251-254.

Device for Prolonged Continuous Change and Agitation of Fluids. *Anat. Rec.*, Vol. 46, 1930, pp. 41-43.

Critical Review of the Controversy Concerning Metabolism in the Enamel. J.A.D.A., 1931, pp. 697-710.

SWANSON, J. H.: Age Incidence of Lines of Retzius in Enamel of Human Permanent Teeth. J.A.D.A., 1931, p. 819.

Relation of Growth Velocity to the Quality of the Enamel. J.A.D.A., 1931, pp. 2174-2176.

WHITE, H. T.: Investigation Regarding the Possible Traumatic Origin of Enamel Tufts. J.A.D.A., 1931, pp. 2374-2378.

Note.—Those affiliated with the present activities of the Research Commission and contributing to the New Orleans Program were:

BUEST, T. B.: Action of Enamel and Dentin Metabolism.

BLUM, THEODOR: Clinical Oral Pathology.

BROWN, H. C.: Supplemental Résumé of the Research Activities of Organized Dentistry, Listing Published Reports and Papers.

PAFFENBARGER, G. C., and SCHOONOVER, I. C.: Preliminary Report on Silicate Cements.

SHELLING, D. H., and ANDERSON, G. M.: Relation of Rickets and Vitamin D to the Incidence of Dental Caries, Hypoplasia and Malocclusion in Children.

SOUDER, WILMER, and BEALL, J. R.: Testing of Certified Dental Material.

1816 Franklin Avenue.

Milwaukee skyline.

BUREAU OF PUBLIC RELATIONS

HEALTH EDUCATION COURSES FOR DENTISTS AND HYGIENISTS

By J. M. Wisan, D.D.S., Elizabeth, N. J.

IN an attempt to plan a dental health program, a high school principal invited a dentist to address a teachers' meeting. The speaker's knowledge of mouth conditions was profound, but his knowledge of educational principles was negligible. His training in health education consisted of managing a dental health poster contest, arranging a dental speakers' bureau and acting as chairman of a dental society oral hygiene committee. It was not surprising, then, that his suggestions proved inconsistent with the objectives of the school administration. Since he offered a program using obsolete, discarded devices, his audience proved indifferent, though polite. Lack of educational training had been his undoing.

Dentistry's development in the public health field will be hampered if such occurrences become too frequent. Advances made in the past few years are indicative of the possibilities of rapid strides in the future. Both dentists and hygienists are expressing progressive public health viewpoints and displaying leadership in promulgating dental health programs. As public health trends develop, will the prestige of dentistry in public health fields be maintained? The answer would seem to be in the affirmative if dental health educators are adequately trained in public health and health education fields.

This prediction suggests three questions:

1. What constitutes the competent dental health educator?
2. What health education courses are now available to dentists and hygienists?
3. What additional courses may be made available to dentists and hygienists?

THE COMPETENT DENTAL HEALTH EDUCATOR

A dental health educator may be defined as one who has knowledge of dental problems and educational principles which he is able to apply in effective dental health education programs. To attain ranking as dental health educators, dentists and hygienists must be able to inform and guide, among others, laymen, nurses, classroom teachers and school and health administrators concerning dental health practices. Then, too, they must be competent to select and evaluate procedures and materials for dental health education programs. What knowledge and what training will enable them to do so?

1. A primary requisite would seem to be a knowledge of public health as it applies to groups and to individuals. An understanding of the more prevalent and more significant health problems will

Read before the Section on Children's Dentistry and Oral Hygiene at the Eightieth Annual Session of the American Dental Association, St. Louis, Mo., October 26, 1938.

help orient dental phases. Statistical and research technics, as applied to public health problems, will be indispensable. Such subjects as epidemiology, biometrics and nutrition would seem to be necessary.

2. A profound understanding of the history of public health administration might be stressed. Knowing the trend of public health concepts will help dentists and hygienists to plan future dental programs with an eye to long range objectives.

3. Human relationships and social formations, affecting the lives, needs and struggles of individuals and groups, are involved in dental programs. Sociology, then, looms as a basic study.

4. The structure of incomes as an expression of current economic life should be understood. Dental health practices are so closely tied up with community, family and individual finances that the subject of economics must be included in the proffered list of studies.

5. Dental health educators may well study the genesis of beliefs and opinions, how beliefs and opinions play their part in furthering mental operations and how these mental operations influence behavior. Thus, the importance of courses in biology and psychology becomes evident.

6. Dental health educators will need to apply their knowledge of the social sciences to improve present-day dental health concepts and practices. The history of education, the various philosophies of education, educational psychology and the principles of education, then, assume major importance. As dental health education programs reach adults and children as well as those who are actively engaged in teaching health, adult education, early childhood education, elementary and high school education and teaching in institutions of higher learning should have a place in the training of the dental health educator. Also health education technics for the radio, health center, interview and newspaper as well as other written material and visual aids should be included.

The recommendations presented here concur to some degree with the educational qualifications as adopted by the state and territorial health officers with the United States Public Health Service. (See addendum for complete recommendations.)

That dental health educators need the suggested training can be realized by analyzing various methods used in health education programs. Two of the most common procedures may be cited as examples: the teaching unit in school programs and the panel discussion for adult education. Both of these methods owe their development to current trends in educational philosophy and psychology. A dental health educator who attempts to apply a teaching unit or to arrange a forum discussion without a working knowledge of educational principles, psychology and the other social sciences will be sorely handicapped.

A distinction must be made between the private practitioner—dentist and public health dentist. Likewise, the dental hygienist must be differentiated from the dental hygiene teacher.

Curricula in present day dental and dental hygienist schools are developing competent dentists and hygienists. Unfortunately, this competency does not include the field of health education. The progress of preventive medicine goes on in schools of public health. Preventive dentistry must likewise have its public health institutions of learning.

COURSES NOW AVAILABLE

In the past, almost all schools of education and public health provided courses for dentists and hygienists, who had to make their own selection and application. Courses were accredited toward the various degrees with no thought of dental programs. This is true at the pres-

ent time in most states. However, a few educational institutions, influenced by the Federal Social Security Act, the United States Public Health Service and the Children's Bureau, are beginning to realize the need of courses specifically planned for dentists and hygienists interested in dental public health programs.

From communication with a number of colleges, it was learned that the following courses were available:

1. For certification as dental hygiene teachers in New York State, the education department requires of hygienists 18 points, obtainable through such courses as:

Educational sociology
Child hygiene
Nutrition
Bacteriology
Family case work
Sociology and health service in the public schools

2. Schools for dental hygienists are now including within their curriculums such subjects as:

Educational school work*
Health care of the family*
General psychology*
Introduction to sociology*
Nutrition hygiene†
Child hygiene†
Community dental hygiene†
Child psychology†

3. Public health courses for dentists.

Massachusetts Institute of Technology offers to dentists a course leading to a certificate in public health. This course requires:

1. At least one full academic year in residence with the satisfactory completion of 96 units of A or B subjects, including thesis.

2. An approved survey of research in public health.

3. Creditable passing of an examination covering the general field.

4. One month of field work.

Tuition costs are estimated at $600.

The following courses are listed as minimum essentials:

Personal hygiene and nutrition
Bacteriology
Communicable diseases
Public health administration
Public health laboratory methods
Immunologic methods
Municipal sanitation
Vital statistics

As electives, the following are included:

Epidemiology
Advanced bacteriology
Health hazards in special industries
Advanced parasitology
Pathology
Public health problems
Public health field work
School health administration
Biochemistry
Industrial hygiene
Theoretical biology
Parasitology

Students taking the certificate in public health in the field of health education may substitute for the laboratory work in the field of sanitary and diagnostic bacteriology an equal number of units in the field of health education and school health. Courses in the Harvard Graduate School of Education and in the School of Education of Boston University are available as electives.

Harvard University offers a course in dental public health which leads to a certificate of public health and one to a degree of master of public health. These courses occupy a full academic year with tuition of $400. Training is given not only in health education and public health, but also in pedodontia, biology and medicine in dentistry.

The University of Michigan offers to graduate dentists a group of courses leading to a master's degree. Thirty hours of credit in courses are required in addition to practical field work and the sat-

*Bull. Univ. Minnesota.

†Bull. Columbia Univ.

isfactory passing of a final comprehensive examination. Among the courses listed are:

Hygiene:
- Child hygiene
- Nutrition
- Physiologic hygiene
- Communicable diseases and epidemiology
- Public health statistics
- Sanitation

Dentistry:
- Oral hygiene and preventive dentistry
- Oral pathology and oral communicable diseases
- Pedodontia

Electives: Hygiene:
- School health programs
- Methods and materials in school health education
- Journal club, review of current literature in public health
- Adult health education (public health publicity)

Electives: Dentistry
- Oral surgery
- Oral surgery clinic
- Orthodontia
- Dental caries research
- Surgical treatment of pyorrhea
- Operative dentistry
- Medicine, internal medicine

Electives: Education:
- Educational psychology
- Psychology of child development

Columbia University offers a special short course in public health for approved dentists. By arrangement between the School of Dental and Oral Surgery and the DeLamar Institute of Public Health, a special course for graduate dentists has been presented as one of the graduate studies in medicine offered at the College of Physicians and Surgeons, Columbia University, in 1938-1939. This course is held weekly throughout the academic year for thirty sessions of two hours each. This course, given by members of the staff of the DeLamar Institute of Public Health, covers the following general topics:

1. Preventable diseases
2. Public health administration
3. Epidemiology
4. Sanitary science
5. Industrial hygiene and medicine

Refresher Courses.—Frank C. Cady, dental consultant for state health authorities, has initiated a number of "refresher courses," to be given under the direction of state health departments. These courses are given in the field and have proved convenient for practicing dentists.

SUGGESTIONS FOR FUTURE COURSES

1. More emphasis should be placed on health education in public health courses for dentists and hygienists. These health education courses should have specific dental objectives.

2. As dentists become trained in the social sciences and health education, they may be given the responsibility of presenting courses to dentists and hygienists in public dental health schools. They may likewise give accredited educational courses to nurses, teachers and social workers in teacher-training institutions. This is suggested because the application of such courses to dental problems may be made more practical if offered by qualified dentists or hygienists.

There is another reason for training dentists and hygienists to give dental health education courses to nurses and classroom teachers. Every nurse and every teacher taught to participate in the dental program reinforces the ranks of dental health educators. One dentist, presenting courses in various sections of a state, can enlist hundreds of field workers and classroom teachers in a widespread dental health program.

3. Accredited educational courses should be made more available to in-service dentists and hygienists. Just as in-service teachers and nurses have ample opportunities for accredited extension

training, so should in-service dentists and hygienists be offered accredited public health education.

4. Dental colleges may include public health and health education courses to initiate dental students in public health technics and encourage them to participate in public health programs. Also postgraduate courses may be arranged by dental colleges collaborating with education and public health institutions.

5. Courses in health education, prepared by the United States Public Health Service, collaborating with recognized universities and teacher training institutions, may be accredited toward a certificate of public health dentistry or a B.S. degree in education.

6. Only dentists with suitable and adequate experience or college training should be appointed as directors of dental health programs. If such men are not available and if it is desired to train candidates through Social Security funds, final appointments should be postponed until they meet requirements.

CONCLUSION

At the present moment, the suggestion that dentistry will be among the leaders in health education may seem far reaching; the proposals for more adequate dental public health courses may seem theoretical. Nevertheless, this discussion is concluded with a truly confident note: How simple it will seem after it has been attained.

ADDENDUM: QUALIFICATIONS FOR PUBLIC HEALTH DENTISTS

I. Basic educational requirements for the public health dentist shall be:

A. The degree of doctor of dental surgery (or equivalent dental degree) from a reputable dental school and eligibility to examination for dental licensure in the state where service is to be rendered.

B. Not less than three years of clinical experience in the general practice of dentistry or in a hospital of acceptable standards. Preference shall be given to candidates who have had training and experience in children's dentistry and oral hygiene.

II. Special qualifications:

A. Pending the development of a reserve of personnel having graduate training in public health work, the following minimum qualifications shall apply as a standard in the selection of public health dentists for jurisdictions of less than 150,000 population, or those in subordinate positions in larger jurisdictions.

1. Candidates for appointment shall be not more than 35 years of age when first specializing in public health work. Preference shall be given to candidates in the following order:

a. Those who have had training and experience in children's dentistry.

b. Those who have had three or more years' experience in the general practice of dentistry.

2. Personnel selected shall already have had or shall agree to take before assuming duty not less than the first semester course in a recognized school of public health.

B. For public health dentists of jurisdictions having populations of more than 150,000; for staff positions with state health departments, and for positions having the responsibility of supervisory and consultant service, the following standard of qualifications shall apply:

1. Not less than one year in residence at a recognized university school of public health and the satisfactory completion of a course of study in the fundamental subjects in preventive medicine and dentistry.

a. Such knowledge of biostatistics as

Excerpt from the report of the Joint Committees from the State and Provincial Health Authorities of North America and from the State and Territorial Health Officers with the U. S. Public Health Service on the qualifications and training of Public Health personnel. Passed by the Joint Conference April 12, 1938.

will give the individual a sound conception of the mass phenomena of disease; familiarity with the methods of collecting, recording and studying statistics on vital phenomena, and ability to interpret the results of the analysis of such material.

b. Some knowledge of general or theoretical epidemiology and training in the collection, recording, analysis and interpretation of epidemiologic information regarding the commoner diseases.

c. Familiarity with the general historical background of health administration, a general knowledge of the forms and methods of operation of health departments of the national government, and of the states and local units, and acquaintance with the standard procedures of health administration.

d. General knowledge of the usual methods of water purification and sewage disposal.

e. Familiarity with the dangers from, and the general methods of securing protection against, diseases transmitted by foods.

f. Familiarity with the clinical aspects of the commoner communicable diseases.

g. Familiarity with the principles of nutrition. He should possess a knowledge of basic food requirements; not only those that are necessary to life, but also those which represent optimum conditions for production of the greater vigor and stamina. He should have sufficient knowledge to recognize those actual clinical entities that may be produced by a faulty diet.

h. Familiarity with all the technics of health education, their applicability and limitations. This includes such technics as news releases, radio broadcasts, pamphlets, correspondence, group meetings, individual conferences and home visiting. He should also possess a knowledge of the basic principles controlling human behavior, and the manner of applying them to health education programs.

i. Familiarity with the various dental hygiene programs being conducted and knowledge of the application of principles and practices that can be applied to the organization and administration of dental health services.

j. Sufficient knowledge of oral pathology and oral manifestations of communicable diseases to perform personally simple diagnostic procedures for the recognition of symptoms of the diseases of the mouth and the oral manifestations of the commoner communicable diseases.

k. Familiarity with the management of children in dental practice and the clinical procedures used in the correction of dental defects of children of all ages.

2. Not less than six weeks of field experience under proper supervision in a suitable health organization.

III. Exceptions to the foregoing standards for public health dentists may be made only when candidates for positions have, through experience and practical training, proved ability to perform successfully the duties of the position for which application is made.

APPRECIATION CARDS

In response to a number of requests for material of this kind, the Bureau of Public Relations offers A.D.A. Members the 3½ by 5½ inch card illustrated herewith. 100 cards, 75 cents; 100 envelopes to match 75 cents. Order from the Bureau of Public Relations.

PLEASE ACCEPT MY THANKS FOR REFERRING

_____ TO ME

FOR DENTAL SERVICE. I WILL DO MY UTMOST TO JUSTIFY YOUR EXPRESSION OF CONFIDENCE.

SINCERELY,

_____ D.D.S.

NEW DENTAL HEALTH EDUCATIONAL MATERIAL

FOUR new motion picture films for adult education: 1. The Life of Your Artificial Denture. 2. Facial Changes. 3. Partial Dentures and Bridges. 4. How to Use Artificial Dentures, 16 mm. films developed by George H. Burtenshaw, will enable the dentist to present an interesting and valuable lecture to adult groups, Kiwanians, Rotarians, women's clubs, etc. They will also afford an excellent program for a dental society meeting.

Each film is about 15 minutes in length. They demonstrate the relationship between resorption and facial changes and the necessity for periodic replacements of dentures. Each film rents for $1 a showing, or $3 a week plus express. For reservations, write to the Bureau of Public Relations, American Dental Association, 212 E. Superior Street, Chicago, Ill.

BLOTTERS

These six blotters illustrated, in 2 colors, are reproductions of winning designs submitted in the NATIONAL POSTER CONTEST

Can be mailed monthly to patients — or given to children for school use.

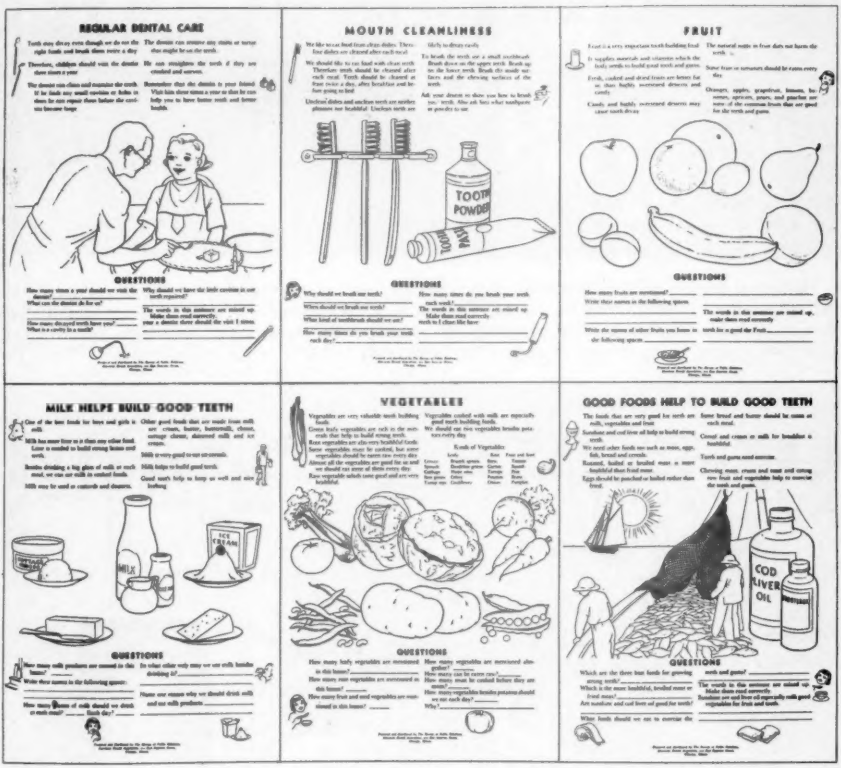
Sample Set of 6, 10c	50 Sets (300 blotters).....$4.50
25 Sets (150 blotters).....$2.50	100 Sets (600 blotters).....$7.50

Blotters for children and adults: These 3½ by 6 inch blotters may be ordered from the Bureau of Public Relations, American Dental Association, 212 E. Superior St., Chicago, Ill.

DENTAL EDUCATIONAL LEAFLETS FOR THIRD GRADE CHILDREN

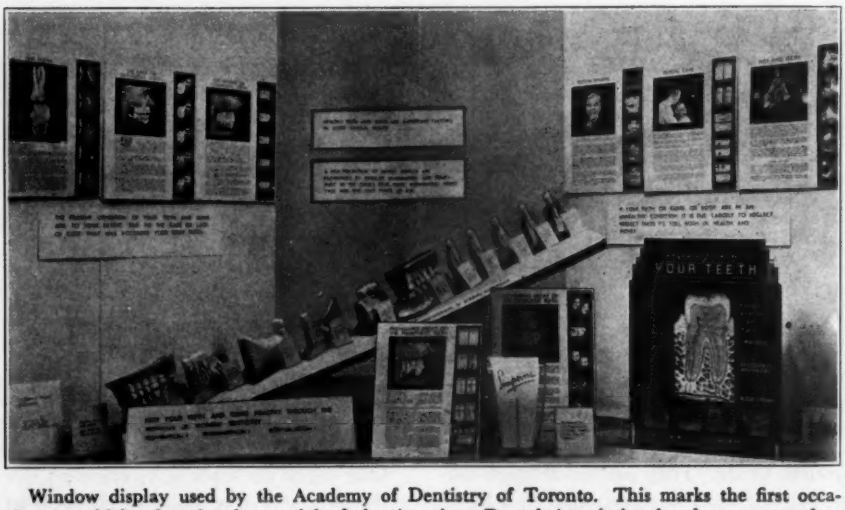
THE six 8 x 11 inch-leaflets shown in the accompanying illustration are offered as seat work for children in the third or fourth grade. They are based upon material originally designed and used by C. Carroll Smith in the Peoria, Ill., schools.

The lessons are to be studied and the questions answered by the children. The drawings can then be colored with crayon or water colors. On the reverse side of each leaflet is an additional dental lesson.



One set of six leaflets, 5 cents; 25 sets of leaflets, 50 cents. Address the Bureau of Public Relations, American Dental Association, 212 E. Superior St., Chicago, Ill.

Historical review of the treatment of fractures of the jaws; displayed at the American Dental Association 1938 Session by G. M. Dorrance, J. W. Bransfield, J. H. Gunter and Philip P. Gross. This 90-foot exhibit consisting of photographs, models and moulages presented a historical review of the treatment of jaw fractures from 300 B.C. to the present time.



Window display used by the Academy of Dentistry of Toronto. This marks the first occasion on which educational material of the American Dental Association has been exported to and displayed in Canada. Chiefly in response to representations made by the Canadian Dental Association, the Commissioner of Customs at Ottawa made a special ruling to allow the material to enter Canada duty free on bond. The display was arranged by the Academy of Dentistry of Toronto in prominent windows of Canada's two largest department stores.

DENTAL ECONOMICS

EFFECT OF SOCIAL AND ECONOMIC STATUS UPON DENTAL CARIES

By CARL GREENWALD,* D.D.S., M.S.D., Chicago, Ill.

THE PROBLEM

FROM time to time, statements have been made concerning the effect of the social and economic status on both tooth eruption and caries. In order to determine these effects, the present study was devised. In it, an attempt is made to determine whether, in children of different school grades who come from different economic and social levels, there is a difference in the incidence of (1) caries; (2) fillings in both the deciduous and the permanent teeth; (3) freedom from dental caries, not including filled teeth; (4) first permanent molars missing in the upper and the lower arch; (5) first permanent molars present, but needing extraction because of either gross decay or abscess formation; (6) treated caries per child, and (7) carious teeth and fillings. For children of different ages who come from different economic and social levels, the percentage of permanent teeth, erupted and still present, was also determined.

METHOD AND PROCEDURE

Temporary dental units were established in each of three schools studied. In the first school, designated as school A, the children had the highest economic and social rating. In the second, designated as school B, the children were of the middle-class economic and social rating. In the third, designated as school C, the children were of the lower economic and social level. All of the children studied were of the white race, but of various nationalities.

The average rental in the neighborhood surrounding school A was $43.50 per month; the average rental in the neighborhood surrounding school B was between $29.30 and $36.80 per month, and the average rental in the neighborhood surrounding school C was between $8.90 and $29.20 per month.

The economic and social levels of the three school groups were determined from census tracts of Chicago by community areas. The economic and social status of families were based on the equivalent monthly rentals of 832,291 homes, and are from a study by Newcomb and Lang, of the social science research committee of the University of Chicago, published in 1934.

The examinations of the children were carried out in one school at a time. A dental hygienist was selected to aid in both a professional and a clerical capacity.

The examinations were conducted with a child seated in a good light, fac-

*Chief, Division of Dental Hygiene, Chicago Board of Health.

Read before the Section on Operative and Preventive Dentistry at the Seventy-Fifth Annual Midwinter Meeting of the Chicago Dental Society, February 16, 1939.

ing the examiner. With the aid of an explorer, mouth mirror and tongue depressor, each tooth was carefully inspected for the presence of caries and fillings.

Every child in the three schools, from kindergarten to the eighth grade, was examined, and the findings were noted on a chart devised by the author.

For the purpose of recording the eruption and the presence or absence of both permanent and deciduous teeth, examinations were conducted in the same school in the same manner, except that twenty-five children, boys and girls, were picked at random from each grade and were recorded according to their age. As each child was examined, the teeth, permanent or deciduous, partially or completely erupted, were checked in their proper position.

TABLE 1.—TOTAL NUMBER OF CHILDREN EXAMINED IN THE STUDY OF CARIES BY SCHOOLS AND GRADES

Grade	School A	School B	School C	Total
Kindergarten	45	49	28	122
1	60	81	71	212
2	75	81	83	239
3	70	85	75	230
4	81	75	80	236
5	75	89	81	245
6	84	84	84	252
7	90	88	74	252
8	85	111	113	309
Total	665	743	689	2,097

COMMENT

It will be noted from Table 2 that the indications of caries (cavities and fillings) per child are much greater in the kindergarten, first grade and second grade in the class C school than in the A and B schools. After the fifth grade, however, the indications of caries more nearly approach the same level in all three schools.

The difference in the early grades may be explained on two bases: first, because of the low economic status of the children in the class C school, the prenatal diet of the mothers may have been inadequate; second, the care of the teeth, from the standpoint of both mouth hygiene and dental care, may have been faulty; or the greater number of indications of caries may be the result of both of these facts combined.

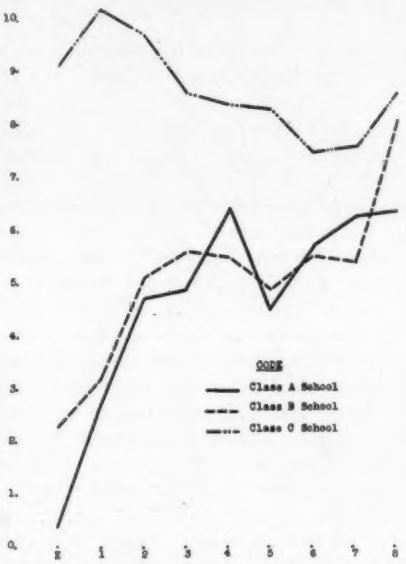


Fig. 1.—Average number of indications of caries (cavities and fillings) per child, including children free from caries.

It is impossible to state, from the data which we have collected, which of these conditions is responsible. The fact that

the difference in the incidence of indications of caries tends to become about the same as the children reach the fifth grade would indicate, it may be argued, that the prenatal diet is the factor of greatest importance in the prevention of early caries. Otherwise, it would be expected that the difference in incidence of caries would remain the same with the increasing age of the children, since it is to be expected that mouth hygiene and dental care would neither improve in the children of the low economic status nor necessarily become less adequate in children of the higher economic groups as age increases.

Another fact which might be taken into consideration to explain why the incidence of the indications of caries tends to become about the same as the children increase in age is the increased consumption of carbohydrates, particu-

TABLE 2.—INCIDENCE OF INDICATIONS OF CARIES (CAVITIES AND FILLINGS) PER CHILD, INCLUDING NUMBER OF CHILDREN FREE FROM CARIES BY SCHOOL AND GRADE

Grade	School	No. Children Examined	Fillings		Caries		Total	No. of Indications of Caries per Child
			Deciduous	Permanent	Deciduous	Permanent		
Kindergarten	A	45	30	3	33	0	66	1.4
	B	49	27	0	86	1	114	2.3
	C	28	9	0	242	5	256	9.1
1	A	60	112	4	99	8	223	3.7
	B	81	104	0	169	78	341	4.2
	C	71	5	4	528	194	731	10.2
2	A	75	168	47	158	61	434	5.7
	B	81	100	31	260	51	442	6.1
	C	83	21	29	489	269	808	9.7
3	A	70	185	75	106	48	414	5.9
	B	85	133	75	198	158	564	6.6
	C	75	10	34	340	261	645	8.6
4	A	81	189	144	138	100	571	7.04
	B	75	106	130	122	134	492	6.5
	C	80	16	95	187	374	672	8.4
5	A	75	78	196	68	74	416	5.5
	B	89	74	136	128	188	526	5.9
	C	81	8	89	77	500	674	8.3
6	A	84	70	300	45	149	564	6.7
	B	84	25	220	77	227	549	6.5
	C	84	3	68	44	510	625	7.5
7	A	90	21	408	26	210	665	7.3
	B	88	15	297	19	236	567	6.4
	C	74	0	36	10	523	569	7.6
8	A	85	2	397	8	224	631	7.4
	B	111	2	404	11	486	903	8.1
	C	113	0	114	15	782	911	8.0

larly sugar, which possibly might occur in the children of the higher economic status. On the other hand, we know of no reason to believe that a greater difference in the consumption of sugar exists in children of higher economic status and those of lower status after they reach the second grade than before this period. Nevertheless, this possibility must be borne in mind.

The variations in the incidence of untreated caries in the children in the three schools is shown in Figure 1. The trend as far as incidence of untreated caries is concerned is about the same as that for the indications of caries. However, it is found that there is a progressive increase in the incidence of untreated caries in children in the class A and B schools with increasing age, and there is a decrease in the incidence of untreated caries in children in the class C school with increasing age, after the second grade.

TABLE 3.—TOTAL NUMBER OF FILLED OR TREATED CARIOUS CAVITIES PER CHILD BY SCHOOL AND GRADE

Grade	School	Fillings Present		Total	No. per Child
		Deciduous	Permanent		
Kindergarten	A	30	0	30	0.66
	B	27	0	27	0.55
	C	9	0	9	0.32
1	A	112	4	116	1.9
	B	104	0	104	1.2
	C	5	4	9	0.12
2	A	168	47	215	2.8
	B	100	31	131	1.6
	C	21	19	40	0.48
3	A	185	75	260	3.7
	B	133	75	208	2.4
	C	10	34	44	0.58
4	A	189	144	333	4.1
	B	106	130	236	3.1
	C	16	95	111	1.3
5	A	78	196	274	3.6
	B	74	136	210	2.3
	C	8	89	97	1.2
6	A	70	300	370	4.4
	B	25	220	245	2.9
	C	3	68	71	0.84
7	A	21	408	429	4.7
	B	15	297	312	3.5
	C	0	36	36	0.48
8	A	2	397	399	4.6
	B	2	404	406	3.6
	C	0	114	114	1.0

This again seems to indicate the greater influence of the prenatal diet on the incidence of caries in children up to the second grade, and the apparent lack of other factors, such as mouth hygiene and dental care, in the prevention of caries after that time.

When children reach the second grade, the deciduous teeth begin to exfoliate and the permanent teeth to erupt. This process continues through the eighth, ninth, tenth, eleventh and twelfth years. As carious deciduous teeth exfoliate and sound permanent teeth erupt, obviously the incidence of caries decreases. Apparently, the children of better economic status are receiving more dental care and have better mouth hygiene; nevertheless, the incidence of caries tends gradually to become about equal in the children of the three economic levels. Hence, we must believe that a better type of mouth hygiene and dental care do not necessarily greatly affect the incidence of caries.

There is a third factor in the picture which perhaps must be considered. This is the diet in the early years of childhood. It would be expected that children of the lower economic levels would have the most deficient diet, and that the incidence of untreated caries in the permanent teeth in this group would be greater than that in the children of the higher levels if an inadequate diet during childhood is a factor in the production of the condition.

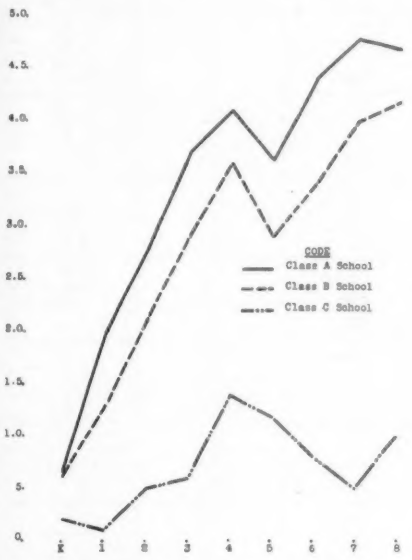


Fig. 2.—Average number of treated carious areas per child by grade.

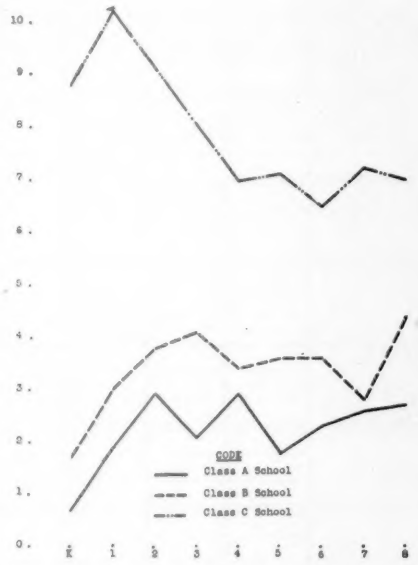


Fig. 3.—Percentage of children free of caries and with no fillings.

These facts are further brought out by a study of the incidence of fillings or treated caries in the children of the three schools. As shown in Table 3 and Figure 2, there is a slight increase in the amount of treated caries in the children in the class C school up to the fourth grade and then a gradual decrease to the seventh grade, followed by a slight

increase to the eighth grade. There is a great deal less treated caries in the deciduous teeth of the pupils in the class C school than in the children of the class A and B schools. In the permanent teeth likewise, there is a great deal less treated caries in the children of the class C school than in those of the class A and B schools.

All of these facts again are explained by the exfoliation of the deciduous teeth and the eruption of the permanent teeth. It is obvious that children of the better economic levels will receive more dental care, and hence carious teeth are more likely to receive dental attention. The drop which occurs at the fourth grade is explained by the fact that about this time deciduous teeth with fillings either exfoliate naturally or perhaps are extracted.

In the study of the children who were completely free from dental caries (Table 5), we find that the highest percentage was in the class A school up to the second grade. (Fig. 4.) The differ-

TABLE 4.—TOTAL NUMBER OF CARIOUS CAVITIES PER CHILD BY SCHOOL AND GRADE

Grade	School	Carious Teeth		Total	No. per Child
		Deciduous	Permanent		
Kindergarten	A	33	0	33	0.73
	B	86	1	87	1.7
	C	242	5	247	8.8
1	A	109	8	117	1.9
	B	169	78	247	3.0
	C	528	194	722	10.1
2	A	158	61	219	2.9
	B	260	51	311	3.8
	C	489	269	758	9.1
3	A	106	48	154	2.1
	B	198	158	356	4.1
	C	340	261	601	8.0
4	A	138	100	238	2.9
	B	122	134	256	3.4
	C	187	374	561	7.0
5	A	68	74	142	1.8
	B	128	188	316	3.6
	C	77	500	577	7.1
6	A	45	149	194	2.3
	B	77	227	304	3.6
	C	44	510	554	6.5
7	A	26	210	236	2.6
	B	19	236	255	2.8
	C	10	523	533	7.2
8	A	8	224	232	2.7
	B	11	486	497	4.4
	C	15	782	797	7.0

ence in the number of children completely free from caries, however, rapidly vanishes with increasing age after the second grade.

These facts again may be explained by the hypothesis that it is the prenatal diet, or some other prenatal influence, which determines the character of the deciduous teeth, but that this same fact does not materially affect the character of the permanent teeth. Its effect may be nullified by other conditions, such as improper mouth hygiene, inadequate dental care or perhaps pituitary, thyroid or any other physical disturbances which occur as the child progresses.

TABLE 5.—PERCENTAGE OF CHILDREN FREE OF CARIES AND FILLINGS BY SCHOOL AND GRADE

Grade	School	No. Children Examined	Children Free of Caries and Fillings	
			No.	Per Cent
Kindergarten	A	45	26	58
	B	49	20	41
	C	28	1	4
1	A	60	21	35
	B	81	15	18
	C	71	1	1
2	A	75	16	21
	B	81	9	11
	C	83	—	0
3	A	70	9	13
	B	85	6	7
	C	75	—	0
4	A	81	6	7
	B	75	4	5
	C	80	—	0
5	A	75	10	13
	B	89	8	9
	C	81	—	0
6	A	84	6	7
	B	84	1	1
	C	84	1	1
7	A	90	2	2
	B	88	4	4
	C	74	—	0
8	A	85	8	9
	B	111	2	2
	C	113	—	0

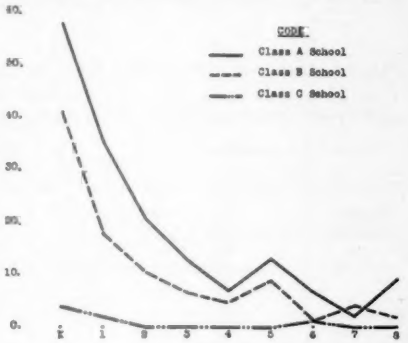


Fig. 4.—Average number of carious cavities per child for each school and grade.

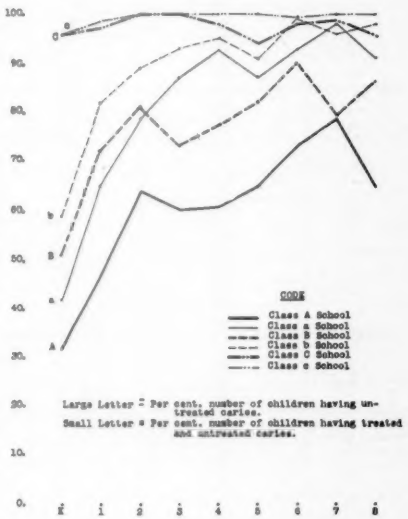

CODE
Class A School
Class a School
Class B School
Class b School
Class C School
Class c School
Large Letter = Per cent. number of children having untreated caries.
Small Letter = Per cent. number of children having treated and untreated caries.

Fig. 5.—Number of children with caries (treated and untreated) compared with number of children with untreated caries.

Since it is to be assumed that the children of better economic status receive

more dental care and have better mouth hygiene, and since the number of children completely free from caries approaches a level in the three schools with increasing age, it again seems evident that mouth hygiene and dental care are not factors of particular importance in keeping teeth free from caries.

Diet during infancy may, of course, play a part in both the incidence of caries and complete freedom from caries and the indications of caries. The diet of this period would probably not have a very great effect on the deciduous teeth, but could be expected to influence the permanent teeth. However, since we have shown that the incidence of untreated caries approaches a level with increasing age as the permanent teeth erupt, it seems that the diet during infancy, which might vary in the children of the three groups, does not play a very great part in the prevention of subsequent caries.

TABLE 6.—FILLINGS AND CARIOUS CAVITIES PRESENT IN PERMANENT AND DECIDUOUS TEETH BY SCHOOL AND GRADE

Grade	School	Fillings Present		Caries	
		Deciduous	Permanent	Deciduous	Permanent
Kindergarten	A	30	0	33	0
	B	27	0	86	1
	C	9	0	242	5
1	A	112	4	109	8
	B	104	0	169	78
	C	5	4	528	194
2	A	168	47	158	61
	B	100	31	260	51
	C	21	19	489	269
3	A	185	75	106	48
	B	133	75	198	158
	C	10	34	340	261
4	A	189	144	138	100
	B	106	130	122	134
	C	16	95	187	374
5	A	78	196	68	74
	B	74	136	128	188
	C	8	89	77	500
6	A	70	300	45	149
	B	25	220	77	227
	C	3	68	44	510
7	A	21	408	26	210
	B	15	297	19	236
	C	0	36	10	523
8	A	2	397	8	224
	B	2	404	11	486
	C	0	114	15	782

The incidence of complete freedom from caries was greatest in the children of class A and B schools in kindergarten and the first grade. However, the incidence of complete freedom from caries rapidly dropped, the decline starting in whatever protected the teeth of the children in higher economic groups before the second grade is either lost or is overbalanced by the development of some other condition. An increased consumption of carbohydrates, particularly sugar,

TABLE 7.—PERCENTAGE AND NUMBER OF CHILDREN HAVING UNTREATED CARIES AND PERCENTAGE AND NUMBER OF CHILDREN HAVING TREATED AND UNTREATED CARIES BY SCHOOL AND GRADE

Grade	School	Children Examined	Children Free from Caries		Children with One or More Carious Teeth	
			No.	Per Cent	No.	Per Cent
Kindergarten	A	45	31	68	14	32
	B	49	24	49	25	51
	C	28	1	4	27	96
1	A	60	32	53	28	47
	B	81	23	28	58	72
	C	71	2	3	69	97
2	A	75	27	36	48	64
	B	81	16	19	65	81
	C	83	0	0	83	100
3	A	70	28	40	42	60
	B	85	23	27	62	73
	C	75	0	0	75	100
4	A	81	20	24	61	76
	B	75	17	23	58	77
	C	80	1	1	79	99
5	A	75	26	35	49	65
	B	89	16	18	73	82
	C	81	5	6	76	94
6	A	84	23	27	61	73
	B	84	8	10	76	90
	C	84	2	2	82	98
7	A	90	21	23	69	77
	B	88	20	23	68	77
	C	74	1	1	73	99
8	A	85	30	35	55	65
	B	111	16	14	95	86
	C	113	6	5	107	95

kindergarten, and by the time the children reached the seventh and eighth grades, the incidence was the same in all three schools. It is obvious, then, that in the children in the higher economic groups, starting at about the first grade level, might, it may be argued, be responsible, as there is no reason to believe

that the type of dental care or mouth hygiene would show any great change in the three groups as the children grow older.

In the children in the class C school, more first permanent molars were missing in both the upper and the lower arch than in children in the class A and B schools. (Table 8.) There were more first permanent molars lost in the lower arch than in the upper, and the incidence of missing first permanent molars increased with the age of the child.

The difference in incidence of missing first permanent molars seems to be readily explained by the failure of the children of the low economic status to have sufficient dental care. Caries is allowed to occur until the teeth are so badly decayed that no restoration can be made, and, consequently, extractions are necessary.

Figures 6 and 7 illustrate the percentage of first permanent molars erupted and present by age groups. The sudden decline of the line in Figures 11 and 18

TABLE 8.—NUMBER OF FIRST PERMANENT MOLARS MISSING BY SCHOOLS AND GRADES

Upper

School	Kindergarten	1	2	3	4	5	6	7	8	Total
A	—	—	—	—	—	1	2	2	3	8
B	—	2	—	2	2	5	5	9	20	45
C	—	—	1	5	4	7	30	22	33	102
Total	—	2	1	7	6	13	37	33	56	155

Lower

A	—	—	1	1	1	1	2	11	4	21
B	—	—	1	4	13	11	12	23	51	115
C	—	4	6	17	25	36	93	71	85	337
Total	—	4	8	22	39	48	107	105	140	473

TABLE 9.—FIRST PERMANENT MOLARS NEEDING EXTRACTION, BY SCHOOLS AND GRADES (DETERMINED WITHOUT ROENTGENOGRAM)

Upper

School	Kindergarten	1	2	3	4	5	6	7	8	Total
A	—	—	—	—	—	—	—	1	—	1
B	—	—	—	—	—	—	—	1	13	14
C	—	—	1	3	1	11	16	17	20	69
Total	—	—	1	3	1	11	16	19	33	84

Lower

A	—	—	1	—	4	—	1	—	—	6
B	—	—	—	—	—	—	10	3	4	17
C	—	3	6	9	17	12	30	35	23	135
Total	—	3	7	9	21	12	41	38	27	158

representing the class C school indicates the loss of the first permanent molars. Because of the common loss of the first permanent molars in the children of the class C school, many types of malocclusion may develop.

It is interesting to note that the loss of the upper first permanent molars in the children of the class C school begins when they are between 8 and 9 years of age, and of the lower first permanent molar when they are 7 or 8 years of age.

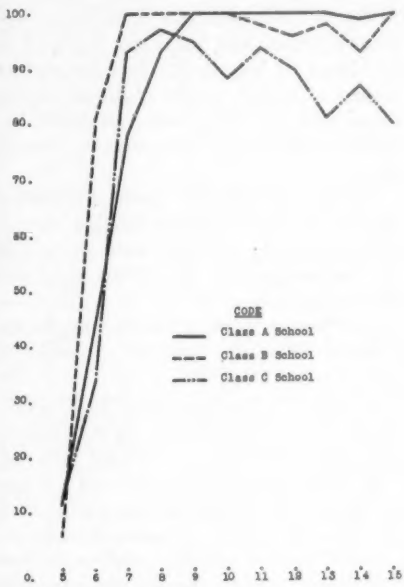


Fig. 6.—Percentage of upper first permanent molars erupted and present, by age group.

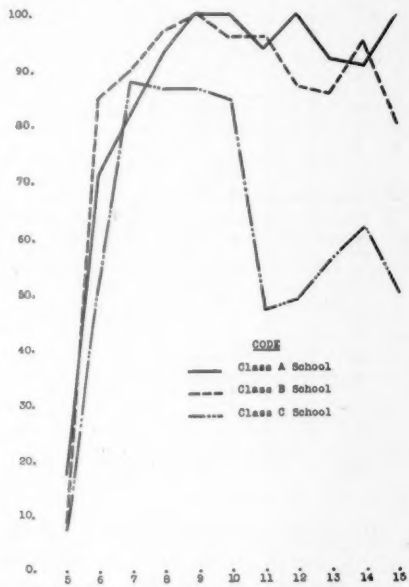


Fig. 7.—Percentage of lower first permanent molars erupted and present, by age group.

A rapid increase in incidence of loss of the lower first permanent molars seems to occur about the tenth year in the class C school, and a less rapid increase in loss of the upper permanent first molar, starting at about the eighth or ninth year. A similar increase in incidence of loss of these teeth occurs in the children of the class B school, but the extent of the loss does not approach that of the class C school. In the class A group, retention of these teeth seems to be the rule. The difference is perhaps accounted for particularly by the adequate dental attention given to the children in the class A and B schools.

Table 9 shows the number of children whose first permanent molars are in need of extraction. This was determined without the use of roentgenograms. However, if roentgenograms had been taken, probably it would have been found that even a greater number of first permanent molars required extraction. This table shows that the need for extraction of the first permanent molars was greater in the class C school than in the two other schools. The reason for this has been previously discussed.

In the study of the percentage of upper and lower permanent teeth erupted and present by age group, it is interesting to note that the time of eruption or

the presence of these permanent teeth is constant in all three schools.

From this study, it has been definitely shown that there is no difference in the eruption or presence of the permanent teeth as far as economic and social status is concerned.

TABLE 10.—TOTAL NUMBER OF CHILDREN EXAMINED IN STUDY OF TOOTH ERUPTION BY SCHOOLS AND AGE

Age	A	B	C	Total
5	25	22	24	71
6	9	20	13	42
7	33	11	14	58
8	23	24	29	76
9	33	32	20	85
10	11	26	18	55
11	27	28	19	74
12	26	29	27	82
13	19	25	22	66
14	17	20	28	65
15	2	5	10	17
16	0	0	7	7
Total	225	242	231	698

However, as indicated before, on Figures 6 and 7, which show the eruption and presence of the first permanent molars, there is a sudden downward trend in the children of the class C school. This has been previously discussed.

CONCLUSION

1. Children in schools of low social and economic status up to the second grade have a greater incidence not only of treated caries, but also of untreated caries. They also have more first permanent molars missing or needing to be extracted.

2. With increasing age after the second grade, the tendency is for the incidence of caries and treated caries to approach practically the same level. The incidence of loss of the first permanent molars is higher in the children of low social and economic status, probably because of failure to have sufficient dental care.

3. The reason for these differences appears to lie in some condition operating prenatally, possibly inadequate diet in the mothers of the children of the lower economic levels.

4. There is little difference in the incidence of caries between the class A and the class B schools.

5. There is evidence that the children in the class A and B schools secure dental care, while class C children do not.

6. The greater amount of dental work in the mouths of the children of the class A and B schools probably accounts for the greater number of first permanent molars present as compared with these teeth in class C school children.

CURRENT LITERATURE

Double Buccal Carcinoma

By L. Abel

The author reports a case of double buccal carcinoma. The patient gave a history of having had an ulcer on the left upper alveolar process six weeks previously. This was followed three weeks later by a similar lesion on the lower left alveolar process. The teeth of the patient were in very poor condition. Leukoplakia was present on the inner side of the left cheek. The lower left submaxillary gland was enlarged. Biopsy of the tissue showed it to be a squamous cell carcinoma.—*Proc. Roy. Soc. Med.*, 32:136, January 1939.

J. F. Volker.

Actinomycosis of the Jaw

By B. Simmonds

Ten days after the removal of a lower left molar, the patient was hospitalized, with marked and painful swelling of the left side of the face. The diagnosis of parotid abscess was made. Incision of the area resulted in only slight relief. Thereafter, several teeth were extracted as possibly responsible for the condition. The symptoms continued to become more acute. Deafness in the left ear was noted. X-ray examination of the jaws and sinuses was negative. The correct diagnosis was established by the finding of colonies of actinomyces in pus taken from the sinuses. Prontosil was used in the treatment without marked success.—*Proc. Roy. Soc. Med.*, 32:138, January 1939.

J. F. Volker.

Management of Compound Injuries of the Face and Jaws

By J. B. Brown

The author devotes a considerable portion of the article to a discussion of fractures of the mandible and maxilla. He states that bony union need never be expected in upper jaw fractures, mainly because of the thin plates of bone present, which do not allow bridging. However, fibrous union usually suffices for steadiness. He also draws attention to the fact that in fractures of the lower jaw, the line may appear open in an x-ray film, even though there is solid functioning union with cortical union evident on surgical exploration. Late lip scars associated with compound injuries to the face often become so hard that it may be thought that a foreign body has been left. This apparently is due to the glands present, and is relieved by irradiation.—*South. M. J.*, 32:136, February 1939.

J. F. Volker.

Teething as a Disorder of Infancy—Its Prevention and Treatment

By M. Witkin

A century ago, the vast majority of infantile ailments were ascribed to "teething." The mortality of this condition alone was often placed as high as 50 per cent. It has now, however, become recognized that it is a physiologic process and as such could never of itself prove fatal or even dangerous. Like pregnancy and menstruation, it is often accompanied by distress, both local and general. In a highly nervous child, many reflex symptoms, and some even of quite alarming character, may become manifest. They may take the form of convulsions, apparently causeless screaming, insomnia, giddiness and head retraction. A case of simple bronchitis may be wrongly diagnosed as pneumonia because of a high temperature and polypnea.

The primary cause of pathologic dentition is probably an inequality of rate of gum resorption and crown advance. The pressure of the advancing crown upon the resistant gum tissue causes irritation and swelling, which, in turn, exerts a backward pressure, forcing the sharp root ends into the pulpal tissue and causing inflammation of the pulp. We thus have two sources of irritation: the inflamed gum and and the pulp, which is capable of producing diverse reflex phenomena. If no gingival inflammation exists, lancing may prove beneficial.

The treatment should be both prophylactic and remedial. Sterilization of all feeding instruments; reduction of other irritation and administration of castor oil, calomel or milk of magnesia often result in improvement.—*Arch. Pediat.*, 56:69, February 1939.

S. B. Finn.

Multiple Dentigerous Cysts

By R. H. Ivy

There are twelve reports of cases of multiple dentigerous cysts in the literature. To these, the author adds six more. All of the cases occurred in children from 8 to 18 years of age. Four of the six cases occurred in children of one family. The treatment is enucleation of the epithelial lining with or without removal of the unerupted teeth involved. The prognosis is good, provided the lining is completely removed.—*Ann. Surg.*, 109:114, January 1939.

J. F. Volker.

Report of a Survey of Mottled Enamel in South Dakota

By H. J. Dean, E. Elvove and R. Poston

This study was made by the U. S. Public Health Service. A total of fifty-three cities, towns or rural communities in twenty-one counties were visited and 3,350 school children were examined. It was found that there are forty-one communities in South Dakota, in twenty counties, where endemic mottled enamel has been demonstrated. In addition, there are thirty other places where mottling of the enamel is probably endemic. The endemicity is apparently limited to smaller communities and rural distrists where the domestic water is obtained from Dakota sandstone.—*Pub. Health Rep.*, 54:212, February 1939.

J. F. Volker.

Infrasellar Adamantinoma

By W. Drummond

An unusual case of adamantinoma which arose in the body of the sphenoid and the nasal septum or approximately in the track of the craniopharyngeal canal, a structure present in only about 0.2 per cent of adults, is reported. The condition was undiagnosed for a period of seven years. During this time, the patient had become progressively worse. Deafness in both ears and complete blindness in one eye were noted. Diagnosis of a tumor-like growth in the central portion of the sphenoid was made from roentgenograms of the skull. The growth was removed by a two-stage operation. Microscopic examination of the tissue showed it to be an adamantinoma. Recovery was rapid, the deafness disappeared and partial improvement in the sight was effected.—*Proc. Roy Soc. Med.*, 32:200, 1939.

J. F. Volker.

Survey of the Conditions Associated with Immunity and Susceptibility to Dental Caries

By N. Bennett

This is an interesting review of primitive, ancient and modern changes in immunity and susceptibility to caries. The frequency of prehistoric caries is in no way comparable to that of modern people. Research toward a better understanding of the process is suggested.—*Brit. D. J.*, 66:193, February 15, 1939.

B. J. Frey.

Indication and Performance of Early Expansion

By M. C. Jordan

Early orthodontic expansion of the temporary dentition is suggested as essential for success in the elimination of such compression anomalies as lower protrusion, crossbite, open bite and "sucking." Details are given for the construction of such appliances.—*D. Rec.*, 59:57, February 1939.

B. J. Frey.

Variation in the Degree of Overbite Between Birth and Three Years

By L. Clinch

In a study of the relation of the dental arches in twenty-five cases, it was noted that in ten the lower arch was slightly lingual to the upper arch in the incisal and molar regions at birth. Of this number, eight had a space at birth and normal occlusion when the deciduous teeth erupted. In two of the ten cases, there was an absence of space and, in the erupted deciduous teeth, a close-bite in the incisal region.

The lower arch in the remaining fifteen cases was slightly lingual in the posterior region and very much so in the incisor region. In six of the fifteen cases, there was a vertical space in the incisal region. Four of the six cases had normal occlusion of the decid-

uous teeth. The fifth of the six cases was normal in occlusion up to 1 year of age and then at 1½ years developed an open bite. The sixth case was a postnormal relationship of the deciduous teeth.

With no vertical space in the incisal region and a posterior relation between the lower arch and the upper in the incisal segment, it was noted that in the deciduous dentition there was a posterior relation of the arches with a noticeable close-bite.

The author states in summary that where there was a space present at birth in fourteen cases, the result at 3 years of age was normal occlusion, whereas only two of the cases showed an open bite of the incisors. In the remaining eleven cases without an incisal space at birth, there was a close-bite in the erupted deciduous teeth. Thus, the space of the incisal segment allows for normal overbite and its absence is unfavorable to normal occlusion.—*D. Rec.*, 58:585, 1938.

B. J. Frey.

Investigations on the Exchange of Phosphorus in Teeth Using Radioactive Phosphorus as an Indicator

By G. Hevesy, J. J. Holst and A. Krogh

There is an exchange of phosphorus atoms present in the teeth with those present in the blood. During the growth of the incisors of rats, the newly deposited phosphorus atoms are to a large extent found in the close vicinity of the dental pulp, but even in the most remote part of the incisors, the presence of newly substituted phosphorus atoms can be established. An exchange of phosphorus atoms thus takes place even in those parts of the incisors which are entirely outside the range of the pulp. The exchange in the molars was found to be less pronounced than that of the incisors, this being presumably due to the fact that these teeth do not grow. In the teeth of young cats, within a few hours, besides an exchange of phosphorus atoms, an increase in the labeled phosphorus content due to the growth of the teeth could be established. An exchange of phosphorus administered has also been proved for human teeth, 1:300,000 of the phosphorus administered being found in each tooth. The replacement of 1 per cent of the phosphorus content of a human tooth by phosphorus atoms taken up with food takes about 250 days.—*Kgl. Danske Videnskab. Selskab. Biol. Med.*, 13:34, 1937; *Chem. Abstracts*, 32:2597, 1938.

Marian Le Fevre.

Incidence of Malignant Tumors of the Head and Neck

By N. Fabricant

Statistics covering 249 cases of malignant tumors of the head and neck were compiled at the University of Illinois, College of Medicine, covering a seven-year period, from 1930 to 1937. The author concludes, from his work, that malignant tumors occur seven times as frequently in men (87.37 per cent) as in women (12.63 per cent). In each sex, approximately the same percentage of malignant tumors occurs in extreme youth and extreme old age. Most malignant tumors occur during the fifth decade of life, with the sixth and fourth decades following in the order named. The vast majority of tumors are of the squamous-cell type.—*Arch. Otolaryngol.*, 29:65, 1939.

Frank Allen.

The Aging Process: A Medical-Social Problem

By G. Piersol and E. Bortz

While there are those of us who are prone to regard only those factors as essential in our profession which have to do with material or mechanical advances, it is well to reflect upon our aims and ambitions as they exert their influence on civilization collectively. Now that science has increased the average length of human life, it is our problem to recognize its place in the community and study the services that it was meant to render. Life expectancy has increased from 21 years in the sixteenth century to near 65 in 1930, and it is reasonable to presume that this gain will continue in the future. Medical and dental aid, control of most common diseases and saving the lives of little ones have been the chief factors. Today, mechanical accidents take the greatest toll.

A century ago, tuberculosis and pneumonia ranked high in the number of causes of death. Within the last seventy-five years, the former has been reduced more than 90 per cent, and early diagnosis and adequate treatment of pneumonia are reducing it to a minor position. Organized campaigns against bacterial and parasitic diseases are wiping them out. Now we are confronted more often

with the degenerative diseases. Of these, obesity, diabetes and cancer are all deserving of study, and with stress on early diagnosis and prevention, rapid strides will undoubtedly be made in their control. By proper application of known facts regarding nutrition, the average life span can be increased at least 10 per cent.

It is now realized that an individual is at his best when the physical, intellectual and emotional patterns have attained their full stature, and this usually comes after the age of 40. He is no longer considered a bad risk as in the past, and there is an undoubted and increased productivity.

It seems that the society which fosters research and more intelligent dealings with the physical process of living should bear the responsibility for developing both an individual more useful than one filled with a lack of appreciation for leisure and conditions which invite senile changes in mind and body. This may mean more research into the physiologic make-up of the mature individual and a redistribution of leisure and time for the population in general. An intensive consideration of the aging process will be found to lead to worth while data.—*Ann. Int. Med.*, 12:964, January 1939.

VIRGIL D. CHEYNE.

Angioneurotic Edema with Lingual and Optic Involvement

A SINGLE woman aged 40, without past medical history of importance, has for two years suffered attacks of swelling and numbness of the left cheek and swelling and numbness of the tongue. The tongue in an hour or so appears covered by blisters, which disappear, however, and the next day the tongue is coated, swollen, shaggy and numb on the affected side. The last attack, one week ago, was accompanied by sudden blindness in the right eye. No other symptoms accompany the attacks; the swelling and numbness of the cheek and tongue last two or three days and then disappear. Physical examination is negative. Laboratory examinations of the urine and blood are negative The fundus of the eye is normal; the visual tests reveal a blind spot which persists ten days after attack. Any suggestions would be appreciated.

Reply.—The patient in all probability has an acute circumscribed edema, also known as angioneurotic edema. This condition was described as early as 1778 by Salpertus, in 1801 by Crichton, in 1848 by Graves, in 1872 by Milton and in 1882 and 1904 by Quincke. It is also known as Quincke's edema. The patient also has the type known as lingual bullosa, in which the tongue becomes covered with multiple vesicles. The blindness is due to a swelling of the optic nerve head. The most important characteristic of this entity is its tendency to appear without reason and after a few hours or days disappear, only to return again at some later time. The edema may involve any part of the body, but usually the skin, the subcutaneous tissue and occasionally the mucous membranes are most often affected. The prognosis is extremely dangerous in cases of edema of the glottis because the patient may become asphyxiated unless intubation or tracheotomy is done at once. There is no special treatment. Overeating, worrying and restlessness should be corrected. Tenseness, panic and emotional states should be prevented if possible. Various foods should be eliminated from the diet if such foods are found to produce an attack (allergic). Epinephrine, ephedrine or amphetamine sulfate should be given for the acute attack if possible. Application of ice to the swelling if it is in the eyelid, cheek, lip or parotid gland will be found to be helpful in reducing the size of the swelling as well as its duration. It is suggested that a textbook on neurology be consulted for further description.—*Queries and Minor Notes, J. A. M. A.*, 112:662, February 18, 1939.

M. K. HINE.

Radioactive Iron and Its Metabolism in Anemia

By P. F. HAHN, W. F. BALE, E. O. LAWRENCE and G. H. WHIPPLE

THE use of radioactive materials in the study of bone and tooth structures, soft tissues and metabolic activities is of growing biologic importance. From the Department of Pathology and Radiology, University of Rochester, comes the report of such a study made using the radioactive iron prepared from the iron isotope through deuteron bombardment. Physiologists admit that understanding of iron metabolism is in a parlous state, but from the evidence presented, it appears convincing that, in dogs under the conditions of the experiment, absorption of

iron is dependent on the need of the body for iron. Nonanemic dogs and dogs made anemic by frequent bleeding and low iron diets were used for the comparative administrations.—*J. A. M. A.*, 111:2285, December 17, 1938.

VIRGIL D. CHEYNE.

Plastic Repair After Removal of Extensive Malignant Tumors of the Antrum

By F. A. FIGI

FACIAL deformity usually does not occur after removal of a malignant tumor of the antrum unless the growth has extended beyond the sinus. The most common disfigurements are elevation and retraction of the upper lip and angle of the mouth, perforation of the cheek and nose and loss of the malar prominence, the inferior orbital border and the eye.

Satisfactory plastic correction of the deformities is possible in most cases. To correct the elevation of the lip, the scarred attachment of the lip and cheek to the superior maxilla is freed and a skin graft is applied to the denuded inner surface of these structures. Perforation of the cheek is repaired by a pedicle flap from the forehead or the thorax. In one case, the meatus was drawn up into the antrum in the process of healing, with resultant drainage of saliva from the nostril. This annoying condition was corrected by transplantation of the duct to approximately its normal position.—*Arch. Otolaryngol.*, 28: 29, 1938; abstr. *Surg. Gynec. & Obst.*, 68: 11, January 1939.

Regenerative Powers of the Jaw Bone in Osteomyelitis (Die regenerativen Kraefte der Kieferknochen bei osteomyelitischen Erkrankungen)

By F. W. PROELL

THERE are still considerable gaps in our knowledge of the biologic changes and the action of regenerative powers in healing in osteomyelitis. The newer researches on the healing of fractures may also throw some light on bone regeneration in osteomyelitis. The changes in the development of pseudarthroses are similar to those changes noted in healing osteomyelitis of the jaws. The clinical course of osteomyelitis of the jaws is well known; also the rule of Axhausen, that extraction in early stages of inflammation of the jaws is to be avoided, with very few exceptions. The author, however, concedes the following to the dental practitioner: When the roentgenogram of teeth or remnants of teeth with infected root canals indicates a central suppuration of the pulp, they are definitely to be extracted.

In acute osteomyelitis of the alveolar process, the bone rapidly regenerates after the sequestrum is exfoliated. In an acute suppurative inflammation of the marrow in the lower jaw, the new bone formation depends on the condition of the bone and periosteum, the type and extent of the infection and, finally, the properly timed, but conservative opening of the abscess. Special types are to be considered: the primary chronic; the dry, nonsuppurative (Partsch and Axhausen), and the chronic suppurative osteomyelitis. The exact relation of these to one another is not as yet clear. In the infant, the condition previously known as "orbital phlegmon" or "sequestrating dental germ inflammation" is considered to be a primary osteomyelitis of the jaws. Of considerable significance in these cases is the "incomplete development of the defense properties of the reticulo-endothelium." In operations on infants, "frequently too much healthy bone is removed as well as the healthy 'anlage' of the remaining teeth." If the line of the epiphysis is also disturbed, the well-known "bird face" develops.

Bacteriologically, *Staphylococcus pyogenes-aureus* and *Staphylococcus pyogenes-albus* are the most important organisms. Of histologic significance is the early formation of osteophytes. Besides the periosteal new bone formation, there is also a paraosteal bone development. There are special references to the work of Lauche of Nuremberg. Conservative management is advised in the treatment of chronic osteomyelitis, especially improvement of the general condition. The use of vitamin-rich foods and the application of ozone mixtures (Fisch and Payr) are recommended. Fully developed abscesses apparent on roentgen examination should be opened. The removal of a sequestrum must "not be too soon in order not to interfere with the resulting ferments, and stimuli which cause bone destruction and bone formation."—*Deutsche Zahn-, Mund-u. Kieferheilk.*, 5:12, 1938; abstr. *Surg. Gynec. & Obst.*, 68:9, January 1939.

PRACTICE IN PARAGRAPHS

This department is intended for busy readers. It aims to tell a vivid story in a few words. Items should be of a practical character, and free from padding—not more than a paragraph or two. We exact no limit, but two hundred words can tell most of these stories. Send in your ideas; they will be welcome.

Inlay Carving Aid—The occlusion of Class I and II inlays with the opposing teeth must be precisely the same as that between normal teeth, especially during the natural development of the maxillae. Many dentists are better mechanics in fitting the casting to the cavity than they are artists in carving the wax pattern.

Before cutting through the fissures on the occlusal surface, obtain a good imprint of the occlusal form with modeling compound in a copper band. This need only take in the occlusal third of the crown so as not to include undercuts. Pour this with plaster. Set the small model so obtained on a flat base of plaster. Now build up a little wall of plaster encircling the model with a space of one-eighth inch. Pour fusible metal into this and you have a metallic form, a replica of the compound impression. Set this aside and continue with the inlay cavity preparation and impression technic.

When the die is filled with warm wax and ready to be carved, warm the fusible metal form in hot water, being careful to use a thermometer in the hot water and keeping it below the melting point of the metal, and press it down over the wax-filled die. Hold in contact until cooled to room temperature and then remove. Very little carving will be necessary beyond flicking away the feather edges of the excess wax.—*James A. Matthews, Glen Cove, N. Y.*

Removing Stains—In using Howe's method of sterilizing cavities, objectionable stains often occur, especially on the cavity margin or the operator's fingers. To remove these stains, apply tincture of iodine until the last trace is gone, then apply alcohol to dissolve the iodine. This treatment can be used in treating sensitive teeth when other methods have failed, because the dark stain can be dissolved. —*Eugene T. Stegall, 1307 Pennsylvania Ave., Ft. Worth, Texas.*

Refrigeration in Dentistry.—The time has arrived when all fully equipped dental offices should have a small electric refrigerator. There are many supplies that should be kept below the ordinary room temperature and excluded from the light. Many drugs that we use should be stored in a cool dark place. In all operations wherein the dentist depends entirely or in part on chemical action for final results, as with silicate phosphate-zinc cement and amalgam fillings and pulp capping, the fluids, powders, alloy and mercury, and the slabs and spatulas, together with the mixing apparatus and the new denture, should be kept at from 40 to 60° F. to prevent chemical action during the combining process. The laws of physics and chemistry so dictate. Again, the dentist needs ice for pulp vitality testing and for cooling x-ray fluids, to say nothing of beverages, on a hot summer day.

A disregard of temperature and humidity in dental operations is affecting the efficiency of many dentists.—*W. Clyde Davis, 814 Security Bldg., Lincoln, Nebr.*

ANNOUNCEMENTS

ANNOUNCEMENTS must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

CALENDAR OF MEETINGS

AMERICAN ACADEMY OF PERIODONTOLOGY, Milwaukee, Wis., July 13-15.

AMERICAN ACADEMY OF RESTORATIVE DENTISTRY, Milwaukee, Wis., July 15-16.

AMERICAN ASSOCIATION OF ORTHODONTISTS, Kansas City, Mo., April 17-20.

AMERICAN BOARD OF ORTHODONTIA, Kansas City, Mo., April 15.

AMERICAN DENTAL ASSISTANTS ASSOCIATION, Milwaukee, Wis., July 17-21.

AMERICAN DENTAL ASSOCIATION, Milwaukee, Wis., July 17-21.

AMERICAN DENTAL SOCIETY OF EUROPE, Lausanne, Switzerland, August 7-9.

AMERICAN FULL DENTURE SOCIETY, Milwaukee, Wis., July 15-16.

AMERICAN SOCIETY OF ORAL SURGEONS AND EXODONTISTS, Milwaukee, Wis., July 14-15.

AMERICAN SOCIETY FOR PROMOTION OF DENTISTRY FOR CHILDREN, Milwaukee, Wis., July 17.

AMERICAN SOCIETY FOR THE ADVANCEMENT OF GENERAL ANESTHESIA IN DENTISTRY, New York City, fourth Monday in March and October.

CLEVELAND (OHIO) DENTAL SOCIETY, April 3-4.

CONGRESS OF AUSTRALIAN DENTAL ASSOCIATION, Melbourne, August 21-26.

DISTRICT OF COLUMBIA DENTAL SOCIETY, second and fourth Tuesdays in each month from October to June, at the United States Public Health Service Auditorium, Washington.

MONTREAL DENTAL CLUB ANNUAL FALL CLINIC, Montreal, Canada, September 27-29.

NATIONAL BOARD OF DENTAL EXAMINERS, May 1-2.

NATIONAL DENTAL ASSOCIATION, New York City, August 14-18.

NORTH ATLANTIC ORTHODONTIC SOCIETY, New York City, April 26.

ONTARIO DENTAL ASSOCIATION, Toronto, June 5-7.

SOUTHWEST DENTAL ASSISTANTS CONGRESS, Oklahoma City, Okla., April 24-28.

SOUTHWEST DENTAL CONGRESS, Oklahoma City, Okla., April 24-28.

SOUTHWESTERN SOCIETY OF ORTHODONTISTS, Kansas City, Mo., April.

STATE SOCIETIES

April

Alabama, at Birmingham (11-13)
Arkansas, at Oklahoma City, Okla. (24-28)
Arizona, at Phoenix (28-29)
Kansas, at Oklahoma City, Okla. (24-28)
Kentucky, at Louisville (3-5)
Massachusetts, at Boston (24-27)
Michigan, at Detroit (17-19)
Missouri, at Oklahoma City, Okla. (24-28)
New Jersey, at Atlantic City (19-21)
New Mexico, at Oklahoma City, Okla. (24-28)
Oklahoma, at Oklahoma City (24-28)
Texas, at Fort Worth (10-13)
Virginia, at Roanoke (10-12)
Wisconsin, at Milwaukee (24-25)

May

Connecticut, at Bridgeport (3-5)
Georgia, at Augusta (15-17)
Illinois, at Peoria (8-11)
Indiana, at Indianapolis (15-17)
Iowa, at Des Moines (2-4)
Maryland, at Baltimore (1-2)
Montana, at Livingston (4-6)
Nebraska, at Omaha (15-17)
New York, at New York City (9-12)
North Carolina, at Raleigh (1-3)
North Dakota, at Grand Forks
Panama, at Panama City (27)
Pennsylvania, at York (2-4)

South Carolina, at Charleston (8-9)
South Dakota, at Aberdeen (22-23)
Tennessee, at Nashville (8-11)
Vermont, at Burlington (17-18)
West Virginia, at Huntington (15-17)

June

Colorado, at Colorado Springs (22-24)
Idaho, at Sun Valley (19-21)
Maine, at Bangor (25-27)
Mississippi, at Gulfport (12-14)
Nevada, at Reno (3)
New Hampshire, at North Conway (4-6)
Utah, at Ogden
Washington, at Wenatchee (11-14)

September

California State, at San Francisco

October

Southern California, at Los Angeles (15-20)
Hawaii, at Wailuku

November

Ohio, at Columbus
Puerto Rico, at Caguas City

STATE BOARD OF DENTAL EXAMINERS

Alabama, at Birmingham, June 19. James A. Blue, 1016 Comer Bldg., Birmingham, Secretary.

Arkansas, at Little Rock, June 19-22. Clarence W. Koch, 817 Donaghey Bldg., Little Rock, Secretary.

California, at San Francisco, May 22; Los Angeles, June 19. Kenneth I. Nesbitt, 515 Van Ness Ave., San Francisco, Secretary.

Connecticut, at Hartford, June 20-24. Almond J. Cutting, Southington, Recorder.

Delaware, July 12-14. Charles R. Jefferis, Medical Arts Bldg., Wilmington, Secretary.

Florida, at Jacksonville, June 26-30. H. B. Pattishall, 351 St. James Bldg., Jacksonville, Secretary.

Illinois, in Chicago, June 20-23; November 7-10. Homer J. Bird, Springfield, Superintendent of Registration.

Indiana, at Indianapolis, June 6. J. M. Hale, Mt. Vernon, Secretary.

Iowa, at Iowa City, May 29-June 2. Hardy F. Pool, Mason City, Secretary.

Maine, at Augusta, June 28-30. Carl W. Maxfield, 31 Central St., Bangor, Secretary.

Minnesota, at Minneapolis, June 23-29. Paul Hagen, Crookston, Secretary.

Montana, at Helena, July 10-13. Leonard A. Jenkin, 401 Ford Bldg., Great Falls, Secretary.

Nebraska, at Lincoln and Omaha, June 12-17. Mrs. Clark Perkins, Lincoln, Director.

New Jersey, June 26-July 1. Walter A. Wilson, 148 W. State St., Trenton, Secretary.

North Carolina, at Raleigh, June 26. Wilbert Jackson, Rich Bldg., Clinton, Secretary.

North Dakota, at Fargo, July 10-13. L. I. Gilbert, 401 Black Bldg., Fargo, Secretary.

Ohio, at Columbus, June 26. Morton H. Jones, 1553½ North Fourth St., Columbus, Secretary.

Oklahoma, at Oklahoma City, June 28-July 1. W. T. Longwell, Frederick, Secretary.

Pennsylvania, at Philadelphia and Pittsburgh, June 20-24. W. A. McCready, 1115 Highland Bldg., Pittsburgh, Secretary.

South Carolina, at Columbia, June 8-10. T. C. Sparks, 1508 Washington St., Columbia, Secretary.

South Dakota, at Sioux Falls, June 26-29. C. H. Boyden, Mitchell, Secretary.

Texas, at Dallas, June 12-16. B. Carl Holder, 1009 Nixon Bldg., Corpus Christi, Secretary.

Vermont, at Montpelier, June 26-28. H. B. Small, 82 Church St., Burlington, Secretary.

Wisconsin, at Milwaukee, June 12-16. S. F. Donovan, Tomah, Secretary.

ARIZONA STATE DENTAL SOCIETY

THE next meeting of the Arizona State Dental Society will be held at the Hotel Westward Ho, Phoenix, April 28-29.

MELVIN V. SAXMAN, *Secretary,*
Professional Bldg.,
Phoenix.

MARYLAND STATE DENTAL ASSOCIATION

THE Maryland State Dental Association will hold its annual meeting in Baltimore May 1-2, at the Emerson Hotel. Visitors will be welcome.

MEYER EGGNATZ, *Secretary,*
Baltimore.

DENTAL SOCIETY OF THE STATE OF NEW YORK

THE Seventy-First Annual Meeting of the

Dental Society of the State of New York will be held May 9-12 at the Hotel Pennsylvania, New York City.

GEORGE C. DOUGLASS, *Chairman,*
Publicity Committee,
80 Hanson Place,
Brooklyn.

PANAMA CANAL ZONE DENTAL SOCIETY

THE Panama Canal Zone Dental Society will meet at Panama City, May 27.

M. L. MILLIS,
Secretary,
Fort Clayton.

WISCONSIN STATE DENTAL SOCIETY

THE Wisconsin State Dental Society will meet at the Schroeder Hotel, Milwaukee, April 24-25.

O. H. MOEN,
President,
Watertown.

NATIONAL BOARD OF DENTAL EXAMINERS

THE National Board of Dental Examiners will hold its next session for the examination of candidates in Parts I and II, May 1-2, in schools where there are five or more candidates. For information and applications, address

MORTON J. LOEB, *Secretary,*
66 Trumbull St.,
New Haven, Conn.

BOARD OF DENTAL EXAMINERS OF ALABAMA

THE Board of Dental Examiners of Alabama will conduct its next annual dental examinations in Birmingham, June 19. All credentials must be in the office of the secretary at least two weeks before the date of the examinations. Address all communications to

JAMES A. BLUE, *Secretary,*
1016 Comer Bldg.,
Birmingham.

CONNECTICUT DENTAL COMMISSION

THE Connecticut Dental Commission will meet in Hartford, June 20-24 for the examination of applicants for license to practice dentistry and dental hygiene and to transact any other business proper to come before it. Applications should be in the hands of the recorder at least ten days before the meetings. For application blanks and further information, apply to

ALMOND J. CUTTING, *Recorder,*
Southington.

DELAWARE STATE BOARD OF DENTAL EXAMINERS

THE Delaware State Board of Dental Examiners will examine candidates for license to practice dentistry in Delaware, July 12-14.

CHARLES R. JEFFERIS, *Secretary,*
Medical Arts Bldg.,
Wilmington.

DEPARTMENT OF REGISTRATION AND EDUCATION OF ILLINOIS

THE Department of Registration and Education of Illinois announces examinations for the registration of dentists, to be held in Chicago, June 20-23 and November 7-10.

HOMER J. BYRD,
Superintendent of Registration,
Springfield.

MAINE STATE BOARD OF DENTAL EXAMINERS

THE next meeting of the Maine State Board of Dental Examiners will be held June 28-30 at the State House, Augusta. Applications, with necessary fee, must be in the hands of the secretary at least ten days prior to the date of examination. Address all communications to

CARL W. MAXFIELD, *Secretary,*
31 Central St.,
Bangor.

MINNESOTA STATE BOARD OF DENTAL EXAMINERS

THE next examination of the Minnesota State Board of Dental Examiners will be held at the School of Dentistry, University of Minnesota, Minneapolis, June 23-29, for license to practice dentistry and dental hygiene in the state. All applications must be in the hands of the secretary at least ten days prior to the examination. Address all communications to

PAUL HAGEN, *Secretary,*
Crookston.

NORTH CAROLINA STATE BOARD OF DENTAL EXAMINERS

THE next annual meeting of the North Carolina State Board of Dental Examiners will be held at the State Capitol, Raleigh, beginning June 26. Applications must be filed with the secretary thirty days before the examination. For application blanks and further information, address

WILBERT JACKSON, *Secretary,*
Rich Building,
Clinton.

BOARD OF GOVERNORS OF REGISTERED DENTISTS, STATE OF OKLAHOMA

THE Oklahoma Board of Governors of Registered Dentists will hold its next examination June 28-July 1 in Oklahoma City. Applications must be filed at least ten days before the date of the examination. For information and application blanks, address

W. T. LONGWELL, *Secretary,*
Frederick.

SOUTH DAKOTA BOARD OF DENTAL EXAMINERS

THE next examination of the South Dakota State Board of Dental Examiners will be held at the Carpenter Hotel, Sioux Falls, June 26-29. Applications should be in the hands of the secretary ten days before the board meeting. For further information, apply to

C. H. BOYDEN, *Secretary,*
Mitchell.

VERMONT STATE BOARD OF DENTAL EXAMINERS

THE Vermont State Board of Dental Examiners will meet June 26-28 in the State House, Montpelier, to examine applicants for license to practice dentistry and dental hygiene. All applications, accompanied by the examination fee, must be in the hands of the secretary at least fifteen days before the date of the meeting. Address all communications to

H. B. SMALL, *Secretary,*
82 Church St.,
Burlington.

AMERICAN ACADEMY OF PERIODONTOLOGY

THE American Academy of Periodontology will hold its twenty-sixth annual meeting July 13-15 at the Hotel Wisconsin, Milwaukee, Wis.

RAYMOND E. JOHNSON, *Secretary,*
824 Lowry Medical Arts Bldg.,
St. Paul, Minn.

AMERICAN FULL DENTURE SOCIETY

THE American Full Denture Society will hold its eleventh annual meeting July 15-16 in the Roof Room of the Hotel Pfister, Milwaukee, Wis.

H. L. HARRIS, *Secretary,*
1353 Lowry Bldg.,
St. Paul.

AMERICAN SOCIETY FOR THE PROMOTION OF DENTISTRY FOR CHILDREN

THE Thirteenth Annual Meeting of the American Society for the Promotion of Dentistry for Children will be held at the Wisconsin Hotel, Milwaukee, Wis., July 17.

RALPH L. IRELAND, *Secretary,*
College of Dentistry,
University of Nebraska,
Lincoln, Nebr.

NORTH ATLANTIC ORTHODONTIC SOCIETY

THE next meeting of the North Atlantic Orthodontic Society will be held in the Hotel Pennsylvania, New York City, April 26. All ethical members of the dental and medical professions are invited.

WALTER H. JACOBS, *Secretary,*
124 West Ninety-Third St.,
New York City.

NATIONAL DENTAL ASSOCIATION

THE National Dental Association will hold the annual convention at the College of Dentistry, Columbia University, New York City, August 14-18. For information regarding registration and accommodations, address

J. A. JACKSON, *Secretary,*
Charlottesville, Va.

COURSES IN FULL DENTURE CONSTRUCTION

THE Prosthetic Department of New York University College of Dentistry announces two postgraduate courses in full denture construction: 1. A full-time course (Course A) daily from 8 a.m. to 1 p.m., beginning May 15 and ending May 20. 2. A part-time course (Course B) every Friday from 1 p.m. to 6 p.m., starting May 26 and ending June 30. For further information, communicate with the office of the dean, New York University, College of Dentistry, 209 E. 23rd St., New York City.

SUMMER COURSES, CHICAGO DENTAL SOCIETY STUDY CLUB

THE Study Club of the Chicago Dental Society announces that short intensive courses will be presented at the study club headquarters in Chicago the week of July 24 (following the American Dental Association meeting in Milwaukee). All dental subjects will be covered. If you are interested in taking a course or courses relative to any dental subject, communicate with the Chicago Dental Society Study Club, 30 N. Michigan Ave., Chicago, and information will be forwarded to you.

MILDRED FLECK, *Supervisor.*

POSTGRADUATE COURSES AT THE UNIVERSITY OF PENNSYLVANIA

THE School of Dentistry of the University of Pennsylvania offers two special postgraduate courses, as follows:

1. Four day general refresher course, including local and conduction anesthesia, radiography, bacteriology, full denture prosthesis, partial denture prosthesis, ceramics, gold inlays and periodontia. The course will be conducted by the faculty of the school, aided by well-known specialists in the fields concerned. Time: June 5-8. Fee: $10, payable with application.

2. Ten day course in oral surgery, exodontia and local and general anesthesia. The course will consist in part of lectures on the subjects mentioned, supplemented by lectures and by demonstrations in anatomy, bacteriology, pathology and roentgenology pertinent to the clinical subjects. Most of the time will be spent in clinical instruction at the Evans Institute and at various hospitals. Time: May 29-June 8. Fee: $75, $25 to be sent with application and $50 payable at the time of registration at the school.

Applicants should state their school and class and dental society affiliation. They are not necessarily restricted to the University of Pennsylvania graduates, but alumni will be given preference in case the numerical limits are exceeded. Applications for each course should be made to the dean, School of Dentistry, University of Pennsylvania, Evans Institute, 40 and Spruce Sts., Philadelphia, Pa.

WASHINGTON UNIVERSITY DENTAL ALUMNI ASSOCIATION

THE Seventy-Third Annual Meeting of the Washington Dental Alumni Association will be held April 12 at the dental school building, 4559 Scott Ave., St. Louis, Mo., with scientific program, dedication of plaque in honor of Jessie Duncan White and a banquet. All ethical members of the profession are invited.

JOHN W. ENLOE, *President.*

AMERICAN DENTAL ASSISTANTS ASSOCIATION

THE Fifteenth Annual Session of the American Dental Assistants Association will be held at Milwaukee, Wis., July 17-21, with headquarters at the Astor Hotel. For further information, address

LUCILE S. HODGE, *General Secretary,*
401 Medical Arts Bldg.,
Knoxville, Tenn.

EXAMINATION FOR APPOINTMENT IN THE DENTAL CORPS OF THE NAVY

A COMPETITIVE examination to select not more than twenty for appointment in the Dental Corps of the Navy will be held July 5 at the Naval Medical School Washington, D. C., Naval Training Station, Great Lakes, Ill., and Naval Training Station, San Diego, Calif. A candidate for appointment in the Dental Corps must be a citizen of the United States and must be between 21 and 32 years of age at the time of appointment, a graduate of a standard dental college, of good moral character and of unquestionable professional repute. Credentials relative to character, citizenship, date of birth and education must be submitted and approved be-

fore an applicant can be authorized to appear for examination.

Senior students in dental colleges may submit applications to appear for the examination held next after their dates of graduation. They should submit with their applications and credentials a letter from the dean of their dental school stating that they are members of the senior class and, immediately after receiving their diplomas, a letter from the dean or registrar of the dental school stating that they have received the degree of doctor of dental surgery or doctor of dental medicine as the case may be.

A circular which contains full information relative to the Dental Corps and describes the method of making application for appointment can be obtained from the Bureau of Medicine and Surgery, Navy Department, Washington, D. C.

EASTERN ASSOCIATION OF GRADUATES OF THE ANGLE SCHOOL OF ORTHODONTIA

THE Thirtieth Annual Meeting of the Eastern Association of Graduates of the Angle School of Orthodontia will be held in New York City, May 8 at the American Museum of Natural History, Central Park West and 79th St., and May 9 at the Hotel Vanderbilt, Park Ave. and 34th St.

E. STANLEY BUTLER, *Secretary,*
55 Locust Ave.,
New Rochelle, N. Y.

AUSTRALIAN DENTAL CONGRESS

THE Tenth Congress of the Australian Dental Association will be held in Melbourne August 21-26. The organization of the Congress is in most capable hands and every effort is being made to reach the same high standard as that of previous congresses and if possible to surpass it.

W. A. MORRISON, *Chairman,*
Publicity Committee,
193 Spring St.,
Melbourne.

MONTREAL DENTAL CLUB ANNUAL FALL CLINIC

THE Fifteenth Annual Fall Clinic under the auspices of the Montreal Dental Club will be held September 27-29, at the Mount Royal Hotel, Montreal.

FRANK A. EDWARD, *Chairman,*
Publicity Committee,
Medical Arts Bldg.,
Montreal, Canada.

UNITED STATES PATENTS APPLICABLE OR PERTAINING TO DENTISTRY ISSUED DURING JANUARY 1939

January 3

No. 2,142,278, to RALPH W. MENDELSON. Medicinal carrying tube.

No. 2,142,537, to EDMOND T. TISZA. Anesthetic ointment.

No. 2,142,780, to RUFUS L. FORTNEY. Method of maintaining a dental varnish dispenser in usable condition.

January 10

No dental patents issued.

January 17

No. 2,143,959, to KARL SCHUMPELT and EDWARD O. LIEBIG. Method of forming amalgam films on amalgam alloys.

No. 2,144,198, to MELVIN E. PAGE. Denture.

No. 2,144,238, to LLOYD W. YOUNG. Blowpipe igniting apparatus.

No. 2,144,392, to JACOB A. SAFFIR. Dental x-ray film package.

No. 2,144,408, to PAUL A. HOLMES. Toothbrush attachment.

No. 2,144,517, to WILLEM F. WESTENDORP. X-ray apparatus.

No. 2,144,524, to ERNEST E. CHARLTON and WILLEM F. WESTENDORP. X-ray apparatus.

No. D-112,970, to RALPH S. VOORHEES. Design for a combined dental table and cabinet.

January 24

No. 2,144,662, to JENS A. PAASCHE. Compressor unit.

January 31

No. 2,145,256, to HENRY H. HARRIS. Muffle.

No. 2,145,257, to HENRY H. HARRIS. Muffle.

No. 2,145,324, to HENRY E. STRAUSS and JOSEPH G. OGDEN. Furnace.

No. 2,145,696, to FRIEDRICH DESSAUER. Arrangement for the execution of deep x-ray therapy.